SR-49

GEOTECHNICAL EXPLORATION
MATADERO CREEK BRIDGES
T PARK BOULEVARD AND LAMBERT AVENUE
PALO ALTO, CALIFORNIA

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GEOTECHNICAL EXPLORATION
MATADERO CREEK BRIDGES
AT PARK BOULEVARD AND LAMBERT AVENUE
PALO ALTO, CALIFORNIA

Prepared for
Santa Clara Valley Water District

May 1990
SFO27979.BB

No. GE 96
Exp. 12/31/93

by
CH2M HILL CALIFORNIA, INC.
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CH2M HILL
Engineers
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May 21, 1990

SFO27979.BB

Mr. James M. Fiedler
Design Division Engineer
Santa Clara Valley Water District
5750 The Almaden Expressway
San Jose, CA 95118

Dear Jim:

Subject: Geotechnical Exploration
Matadero Creek Bridges
at Park Boulevard and Lambert Avenue
Palo Alto, California

We are pleased to transmit these eight (8) copies of our final geotechnical exploration report for the subject project. This report contains the results of our soils and geologic literature review, our site reconnaissance and field exploration, laboratory testing, and engineering analyses, together with geotechnical recommendations for design and construction of the project.

Sincerely,

CH2M HILL

David Von Rueden

David Von Rueden, P.E.

SFC5/508.51

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INTRODUCTION

PURPOSE AND SCOPE

This report presents the results of our geotechnical evaluation for the proposed Matadero Creek bridges at Park Boulevard and Lambert Avenue in Palo Alto, California. The purpose of the work is to evaluate the subsurface conditions at the sites, to identify geotechnical considerations for the design and construction of the project, and to present engineering recommendations regarding the design of the proposed bridges. Our scope of work consisted of the following tasks:

- Review existing available geotechnical and geologic information
- Conduct a subsurface exploration program consisting of two borings at each bridge location
- Perform laboratory testing to evaluate the engineering properties of the soil at the sites
- Perform environmental monitoring in the field and perform laboratory testing to evaluate the potential for soil and groundwater contamination at each site
- Develop geotechnical recommendations regarding design of the proposed bridges
- Prepare this report to include the results of the exploration, laboratory testing, and engineering recommendations

LIMITATIONS

This report has been prepared for the exclusive use of the Santa Clara Valley Water District (SCVWD) for specific application to the project described in this report. Our site evaluation was performed in accordance with generally accepted geotechnical engineering practice. CH2M HILL makes no warranties, expressed or implied, regarding the findings or recommendations presented herein. CH2M HILL is not responsible for claims, damages, or liability associated with interpretation, reuse, or engineering analyses by others using the information contained in this report.

The analyses and recommendations contained in this report are based on the data obtained from soil borings made at specific locations and times, and indicate soil conditions to the depths penetrated. They do not necessarily reflect strata variations that may exist between boring locations. Soil conditions and water levels at other locations may differ from conditions occurring at the boring locations.

During construction, new or additional information regarding the geotechnical conditions may become available. This information should be supplied to CH2M HILL for review. Based on the review, CH2M HILL reserves the right to revise the conclusions and professional judgments presented in this report.

PROJECT AND SITE DESCRIPTION

This project involves removal and reconstruction of two bridges along Matadero Creek, one at Lambert Avenue and one at Park Boulevard. The project locations are shown in Figure 1. The ground surface at both sites is relatively flat, with Matadero Creek providing the only topographic relief. At the time of our field exploration, the creek was dry.

At the Lambert Avenue site, the proposed bridge will be about 9 feet wider than the existing bridge, but in the same location. The existing ground surface and road grade is at about elevation 31, based on National Geodetic Vertical Datum (NGVD). The proposed invert of the channel is approximately the same as the existing invert, at about elevation 19. At the Park Boulevard bridge, the proposed bridge will be about 4 feet wider, and 1 foot deeper than the existing bridge, and will be located approximately 60 feet south of the existing bridge. The existing ground surface is at about elevation 28, and the proposed invert is at about elevation 16.

The bridges are proposed to be rigid frames on spread footings. New U-frame channels will extend from each end. The bridge walls will be fixed at the top, except for a short segment of cantilever wall at Lambert Avenue. We understand that the bearing pressure will be on the order of 2,700 pounds per square foot (psf) for dead and live loads, and 1,500 psf for transient live load. The footings will be approximately 3 feet wide.

EXPLORATION AND TESTING

EXISTING DATA

SCVWD has prepared preliminary engineering drawings (dated February 1, 1988) for the Matadero Creek improvements. These drawings show the proposed realignment, profile of the creek, and general details of the proposed bridges.

A geotechnical report was prepared for the Matadero Creek improvements from Middlefield Road to Park Boulevard (Woodward Clyde Consultants, 1989). Boring 7 for this geotechnical evaluation was located near the Park Boulevard bridge. This boring was drilled in August, 1988, and advanced to a depth of approximately 31 feet. The boring log is included in Appendix A.

Two borings were drilled for the Matadero Creek realignment at the Southern Pacific Transportation Company (SPTC) railroad tracks near Alma Street (CH2M HILL, 1988). These borings are roughly 500 to 600 feet away from the Park Boulevard bridge. Although the soil conditions (as indicated in the boring logs) are similar to the soil conditions at the Park Boulevard bridge, the borings are too far away from the project site to be of use in this geotechnical evaluation.

FIELD EXPLORATION

On July 5, 6, and 7, 1989, a subsurface exploration was performed at the Park Boulevard and Lambert Avenue bridge sites at Matadero Creek. The explorations consisted of drilling two soil borings at each bridge to a maximum depth of 41.5 feet below the ground surface. Borings were drilled with a Mobile B-53 drill rig using hollow-stem augers, under observation by a representative of CH2M HILL's Geotechnical Department. The locations of the borings, one near the existing and proposed upstream and downstream abutments of each bridge, are shown in Figures 2 and 3. Logs of the borings are included in Appendix B. After completion of sampling, the hole was grouted from the bottom of the hole to the ground surface.

Samples of materials encountered in the borings were generally obtained at 5-foot intervals. Standard Penetration Test (SPT) split spoon samples were taken at selected intervals in general accordance with ASTM D 1586. The SPT is used to characterize the consistency or density of in-place soil by measuring penetration resistance expressed as "blow counts, " or "N-value." In the SPT, the sampler is driven three consecutive 6-inch increments. The number of blows required for the second and third increments are summed, and the total is termed the "N-value." Low N-values indicate soft or loose deposits, while high N-values are evidence of hard or dense materials.

Shelby tube samples were recovered in some locations where clay deposits were encountered. The tube samples provide relatively undisturbed soil samples for laboratory testing. The samples were obtained using 3-inch diameter, thin-walled seamless steel tubes that are 36 inches long, in approximate accordance with ASTM D 1587. The tubes were pushed approximately 18 to 24 inches into the undisturbed soil, in one continuous stroke with the hydraulic drive head of the drill rig.

Soil samples were examined in the field and visually classified in approximate accordance with the Visual-Manual Procedure for Description of Soils (ASTM D 2488). Sampling intervals and classification of soil samples are presented in Appendix B. Field boring logs were revised as necessary based on the results of laboratory testing and examination. Pocket penetrometer and/or torvane measurements of unconfined compressive strength were made when the soil consistency permitted such measurements.

Because of the proximity to an area of known groundwater contamination, several soil samples were taken for chemical analyses of volatile and semi-volatile organic compounds. Soil samples for chemical analyses were taken using a Modified California sampler with brass liners. All samples were screened with an HNU Photoionization Detector (PID) in the field for the presence of volatile organic compounds. Samples for chemical analyses were picked up in the field by a representative of Accurex, the local testing laboratory.

LABORATORY ANALYSES

Samples obtained during the field exploration were sent to Woodward Clyde Consultants' laboratory in Pleasant Hill, California for geotechnical testing. Representative samples were analyzed for natural moisture content, grain size, and Atterberg limits. In addition, several unconsolidated-undrained triaxial strength tests and consolidation tests were performed on the relatively undisturbed samples. The tests were generally performed in accordance with applicable ASTM standards. Classification and engineering property test results are presented in Appendix C.

Two soil samples were analyzed by Acurex Corporation, Mountain View, California, for purgeable halogenated organic compounds according to U.S. EPA Method 8010, and for purgeable aromatic compounds according to U.S. EPA Method 8020. Results of these analyses are presented in Appendix C.

GEOTECHNICAL SETTING

REGIONAL GEOLOGY

This project is located in the northern portion of the Santa Clara Valley. Santa Clara Valley is flanked on the west by the Santa Cruz Mountains and on the east by the Diablo Range. The San Francisco Bay and connecting valley to the south lie in a structural trough formed by downwarping and faulting. This trough came into existence late in the Pliocene Epoch (a few million years ago) and over the last one million years has been nearly filled with marine sediments and alluvial materials derived from the surrounding hills.

In the Santa Clara Valley, the upper alluvial deposits are generally divided into the Plio-Pleistocene age Santa Clara Formation (about 10,000 to 2 million years ago) and younger valley alluvium that is late Pleistocene to recent in age (younger than 10,000 to 50,000 years). These two alluvial units are very similar in texture and have the same general origin, mainly as alluvial fan deposits.

The Santa Clara Formation in the project area consists of unconsolidated, poorly sorted, irregularly bedded material ranging in grain size from clay to gravel. The younger valley alluvium consists of unconsolidated deposits of gravel, sand, silt, and clay. These deposits take the form of coalescing alluvial fans and were deposited by the many streams that drain from the Santa Cruz and Diablo Mountains and meander across the valley to the bay. Because of their sequence of deposition, folding, faulting, and erosional history, the younger valley alluvium deposits are an irregular sequence of meandering, permeable stream-channel deposits separated by less permeable silt and clay.

SEISMICITY

The San Francisco Bay Area is recognized as one of the most seismically active regions in the United States. The significant earthquakes that occur in this area are generally associated with crustal movements along well-defined, active faults. The closest active faults of concern to this project include the San Andreas, the Calaveras, and the Hayward faults. Since each of these faults has had a major historic earthquake and has continuing micro-seismic activity due to fault creep, they should be considered capable of future large magnitude earthquakes. The maximum credible earthquake for each of these faults, and the associated bedrock acceleration, is presented in Table 1. The site is located within Zone 4 of the Uniform Building Code seismic design provisions.

Table 1
SIGNIFICANT FAULTS AND ASSOCIATED ESTIMATED BEDROCK ACCELERATION

Matadero Creek Bridges at
PARK BOULEVARD and LAMBERT AVENUE

Fault	Distance from site (mi)	Maximum Credible Earthquake[a]	Bedrock Acceleration at Site[a,b]
San Andreas	6.8	8.25	0.53
Hayward	11.2	7.5	0.40
Calaveras	17.2	7.5	0.32

---

[a] Greensfelder, 1973.
[b] Seed and Idriss, 1981.

SUBSURFACE CONDITIONS

PARK BOULEVARD

The ground surface at the Park Boulevard site is about elevation 28 feet. In general, the subsurface soil conditions at this bridge can be described as stiff sandy clay and clayey sand overlying layers of stiff silty clay. The soil conditions appear to be relatively uniform between the two borings (B-3 and B-4) drilled for the current exploration. Also, there is good correlation between the soil encountered in B-3 and B-4 and the boring performed for previous work near the Park Boulevard bridge site (Woodward Clyde Consultants, 1989).

The top 10 feet of soil consists of stiff sandy clay. A 5 foot thick layer of medium dense clayey sand with gravel was encountered between about elevation 18 and 13 feet. This material overlies layers of stiff to very stiff clay, silty clay, and clayey silt to the maximum depth explored (41.5 feet). The clay soil is of low to moderate plasticity, and slightly overconsolidated, most likely caused by dessication. The natural water content is generally above the plastic limit, but well below the liquid limit. The undrained shear strength of the clay material is on the order of 1,700 psf or greater.

LAMBERT AVENUE

The subsurface exploration indicates that, in general, the bridge site is underlain by deposits consisting of layers of stiff clay and moderately dense clayey sand and gravel. At the upstream end of the bridge (boring B-1), the top 15 feet (from about elevation 31 to 16) consist of stiff to hard clay. This material overlies approximately 10 feet (from about elevation 16 to 6) of well-graded, medium dense, sandy gravel and clayey sand with gravel. From elevation 6 to -5 feet, the soil is a stiff to very stiff silty or sandy clay. Well-graded, medium dense clayey sand and gravel, and sandy gravel extends from elevation -5 feet to the maximum depth explored (41.5 feet).

The soil conditions at the downstream end generally consist of hard sandy clay and firm to stiff clay, and silty clay from the ground surface to about 30 feet deep (elevation 1). From elevation 1 to the end of boring (41.5 feet), the soil is generally a clayey sand and gravel to sandy gravel. The clay soil is of low to moderate plasticity, and slightly overconsolidated.

GROUNDWATER

The groundwater level was measured during drilling (July, 1989) at about 17 feet deep (elevation 15) in boring B-1 at Lambert Avenue, and at about 20 feet deep (elevation 8) in boring B-3 at Park Boulevard. These groundwater levels correspond to a depth of about 5 to 8 feet below the existing channel bottom. We anticipate that the groundwater level will vary with seasonal variations in rainfall and with changes in water level in the creek.

A City of Palo Alto municipal well (The Fernando Well, number 6S3W12R10) is located near the intersection of Ash Avenue and Chestnut Avenue, near the Lambert Street bridge. Historical records indicate that areal groundwater levels have been rising over time, and that groundwater is currently near the ground surface (approximately elevation 33). The groundwater level may drop down to near the creek bottom in the drier months. However, for purposes of the bridge design, the groundwater level should be taken at or near the ground surface.

CONCLUSIONS AND RECOMMENDATIONS

SEISMIC HAZARDS

GROUND SHAKING

Because the project area is near active faults, it is reasonable to assume that the proposed bridges will be subjected to strong ground shaking from at least one moderate to severe earthquake during the life of this project. Based on the data presented in Table 1, the maximum expected bedrock acceleration at the site will be about 0.5g. For design purposes, it can be assumed that bedrock is very deep, more than 500 feet below the ground surface.

LIQUEFACTION

Liquefaction occurs when loose, saturated sand undergoes a rapid loss in strength as a result of vibration from ground shaking. The susceptibility of a soil to liquefaction decreases as its relative density and fines content increase. Liquefaction of the subsurface materials at the site as a result of a major earthquake is unlikely because of the generally fine-grained, cohesive nature of the soil encountered.

ENVIRONMENTAL CONSIDERATIONS

The project is located in an industrial area of Palo Alto. Groundwater contamination has been detected at several properties near the site. A comprehensive description of sources of groundwater contamination at the site is beyond the scope of this report. Additional information regarding groundwater contamination may be obtained from the California Regional Water Quality Control Board (RWQCB) files.

No volatile organic compounds were detected in the air monitoring or soil samples analyzed for the site. However, we believe that the limited field monitoring and analytical results are inconclusive, and that the groundwater may or may not be contaminated. A more definitive assessment of the potential for groundwater monitoring could be made by installing a groundwater monitoring well at each bridge site, and obtaining water samples for analysis.

Also, if dewatering is required during construction, samples of the groundwater should be obtained and analyzed for volatile organic compounds. If groundwater contamination is detected, a special discharge permit may be required to dispose of the groundwater. The contractor should be responsible for all sampling, analysis, and proper disposal of groundwater.

EARTHWORK

EXCAVATION AND DEMOLITION

The bridge sites should be cleared of all surface and subsurface deleterious materials including existing bridge foundations, channel lining, trees and roots, topsoil, and debris, if present. Extreme care should be taken at the Lambert Avenue site not to disturb the 60 kV electric line that runs along the approximate centerline of Lambert Avenue, at about elevation 16. The resulting excavations that extend below the proposed finished subgrade level should be cleaned and backfilled with crushed rock.

TEMPORARY EXCAVATIONS

Temporary excavation bracing or cut-back slopes will be required for the bridge construction. Recommendations regarding temporary excavation slopes, shoring, sheeting, and bracing, or methods to minimize effects on existing utilities and adjacent structures, are not within the scope of this report. These items are highly dependent on the contractor's selected excavation method and construction procedures. For this reason, the contractor should be made responsible for the design of all excavations. The design and construction of all temporary cut slopes and excavation bracing shall comply with the strictest governing safety requirements. The stability of the excavation is dependent on several factors, including the length of time the excavation is left open, weather, surcharge adjacent to the excavation, and other factors.

CONSTRUCTION DEWATERING

All excavations and construction should be performed in a dry condition. The excavation for the bridge abutment footings may encounter groundwater during construction. The contractor should be responsible for all groundwater control in the excavations. If dewatering systems are used, they should be capable of lowering the level of the groundwater to below the excavation bottom to provide a safe, stable platform for workers and equipment. Systems to remove water should be designed, installed, and operated to prevent the migration or removal of fines. The system should also be designed to protect against soil heave.

SUBGRADE PREPARATION

After clearing, stripping, and completion of the required excavation, subgrade soil below the footings and channel bottom should be prepared to a firm, hard, and unyielding condition and then observed by a geotechnical specialist. Any soft spots should be excavated down to suitable subgrade, as determined by a geotechnical specialist, and then filled with crushed rock or lean concrete.

The soil at this site is susceptible to disturbance when saturated in an unconfined condition and then subjected to the traffic of construction equipment and workers. Ponded water will soften the natural soil. All excavations should be free of standing water and loose or disturbed material prior to placement of fill or foundation concrete. The footing and channel lining concrete should be placed immediately after excavation and subgrade approval. If this is not possible, a mud mat should be used. The mud mat should consist of a 2- to 3-inch thick layer of lean concrete placed at the bottom of the excavation onto the prepared, undisturbed subgrade. Alternatively, the subgrade could be protected from disturbance by using a 1-foot-thick (minimum) gravel blanket placed on the prepared surface.

MATERIAL FOR FILLS

There are two alternative materials that can be used for backfill behind the bridge abutment walls. The compaction characteristics of the backfill material should be determined prior to construction by a qualified geotechnical specialist. The first alternative is an imported fill material, which should be a well-graded cohesionless soil and should not contain rocks or lumps larger than 3 inches in greatest dimension, with no more than 12 percent larger than 2.5 inches. No more than 12 percent of the material should pass the number 200 sieve, and the plasticity index of the material should be less than 12. The configuration of the imported backfill material is shown in Figure 4. A 2-foot-thick clay cap should be placed at the ground surface to reduce the rainfall and surface runoff infiltration into the backfill. Onsite clayey soil would be appropriate for use as the surface cap.

The second alternative for backfill is the excavated onsite silty clay, sandy clay, or clayey sand. Only material that has a plasticity index of less than 20 should be used.

COMPACTION

All fill material should be compacted to at least 95 percent of relative compaction as determined by California Department of Transportation (Caltrans) California Test 216, "Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates." Fill material should be spread and compacted in uniform horizontal lifts not exceeding 8 inches in uncompacted thickness. The moisture content of the fill should be within 2 percent, plus or minus, of the optimum moisture content at the time of compaction. Compaction by water jetting or ponding should not be permitted.

BRIDGE FOUNDATIONS

BEARING CAPACITY

We recommend that the proposed bridges be founded on shallow spread footings. The footings can be designed for a maximum net allowable bearing pressure of 2,900 psf for normal dead and live loads, and 4,400 psf for normal dead and live loads plus transient live (wind, seismic). These allowable bearing pressures are based on the bottom of the bridge footings being placed at about elevation 16 for the Lambert Avenue bridge, and elevation 13 for the Park Boulevard bridge. The net allowable bearing pressure is defined as the difference between the gross bearing pressure acting on the base of the foundation and the soil pressure existing at that elevation before excavation. The existing soil pressure may be calculated using a moist unit weight of 120 pounds per cubic foot (pcf) for the soil.

SETTLEMENT

The Lambert Avenue bridge will be founded partly on silty clay, and partly on sandy gravel, thereby causing a potential for differential settlement between the two materials. However, our analyses show that settlement in the two different materials will be approximately equal, and the settlement will occur in approximately the same time frame. For the Lambert Avenue bridge, total settlement will be limited to less than 1 inch. We anticipate that this settlement will occur very soon after placement of the loads, and that long-term settlement is not likely. To reduce the impact of the bridge settlement on the existing kV line, the following mitigative measure has been recommended. The footing line will be broken about 6 inches from either side of the line. The abutment wall will span over the line with a gap of about 6 inches between the bottom of the wall and the top of the conduit. The area around the line between the footing and the wall will be backfilled with soft polystyrene to accomodate any potential settlement.

At Park Boulevard, the soil is relatively uniform below the footing level. Total settlement will also be less than 1 inch. and will occur soon after loading.

EARTH PRESSURE

LATERAL LOADING

Abutment Walls

The lateral pressures acting on the bridge abutment walls fixed at the top (based on the type of backfill selected) are summarized in Figure 4. If imported granular backfill is used, the bridge walls should be designed for a static at-rest equivalent fluid earth pressure of 25 pounds per square foot of depth for static conditions. If onsite clayey soil is used as the backfill, the walls should be designed for an at-rest pressure of 96 pounds per square foot of depth. Hydrostatic pressure of 62 pounds per square foot of depth acting on the entire height of wall should be added to the earth pressure.

Seismic earth pressure should also be considered in the design of the abutment walls. For granular backfill, a uniform seismic earth pressure of 15 H, where H is the height of the wall, should be added to an active earth pressure of 15 pounds per square foot of depth plus hydrostatic pressure. If clayey soil is used as backfill, a uniform seismic earth pressure of 28 H plus hydrostatic pressure would be used. Then, the heaviest loading condition between static (as described above) or seismic earth pressure should be selected for design of the wall.

Cantilever Walls

The cantilever section of wall at Lambert Avenue should be designed for static lateral earth pressure as follows. For granular backfill, an active earth pressure of 15 pounds per square foot of depth, and for clayey backfill, an at-rest earth pressure of 96 pounds per square foot of depth should be used. Hydrostatic pressure should also be added. Uniform seismic earth pressure of 15H for granular backfill and 28H for clayey backfill should be added to the active pressure for the cantilever walls.

Both the cantilever and abutment walls should also be designed to resist any additional lateral pressure resulting from surcharge loads applied at the ground surface immediately adjacent to the walls. Lateral loads should be computed at one third of the vertical surcharge load. Large earthmoving and compaction equipment used adjacent to the walls will induce large lateral pressure onto the walls. For this reason, the soil adjacent to the walls should be compacted carefully, using lightweight equipment as appropriate.

LATERAL RESISTANCE

Resistance to the lateral loading may be developed by passive resistance to the wall pushing into the soil. An allowable passive resistance of 30 h + 850 psf per linear foot of wall, where h equals the height of the wall below the channel lining, can be used for design. See Figure 4.

CONSTRUCTION CONSIDERATIONS

It is neither the intent of this report nor within the scope of the geotechnical work to recommend construction methods or procedures. For the proposed bridges, it is the responsibility of the contractor to implement sound construction methods and procedures in accordance with the strictest governing safety standards.

Variations in soil and geologic conditions are possible and may be encountered during construction. To permit correlation between the exploration data and the actual conditions encountered during construction, all earthwork and footing subgrade preparation should be performed under the observation of a geotechnical specialist.

REFERENCES

CH2M HILL, "Geotechnical Exploration, Santa Clara Valley Water District Creek Modification Projects, Matadero and Adobe Creeks at Alma Street, Palo Alto, California," prepared for Santa Clara Valley Water District, April 1988.

Greensfelder, Roger W., "A Map of Maximum Expected Bedrock Acceleration from Earthquakes in California," California Division of Mines and Geology, 1973.

Seed, H. Bolton and I.M. Idriss, "Ground Motions and Soil Liquefaction During Earthquakes," Earthquake Engineering Research Institute, 1982.

Woodward-Clyde Consultants, "Geotechnical Investigation, Matadero Creek Improvements from Middlefield Road to Park Boulevard, Palo Alto, California," prepared for Santa Clara Valley Water District, dated March 17, 1988. [Actual date 1989.]

FIGURES

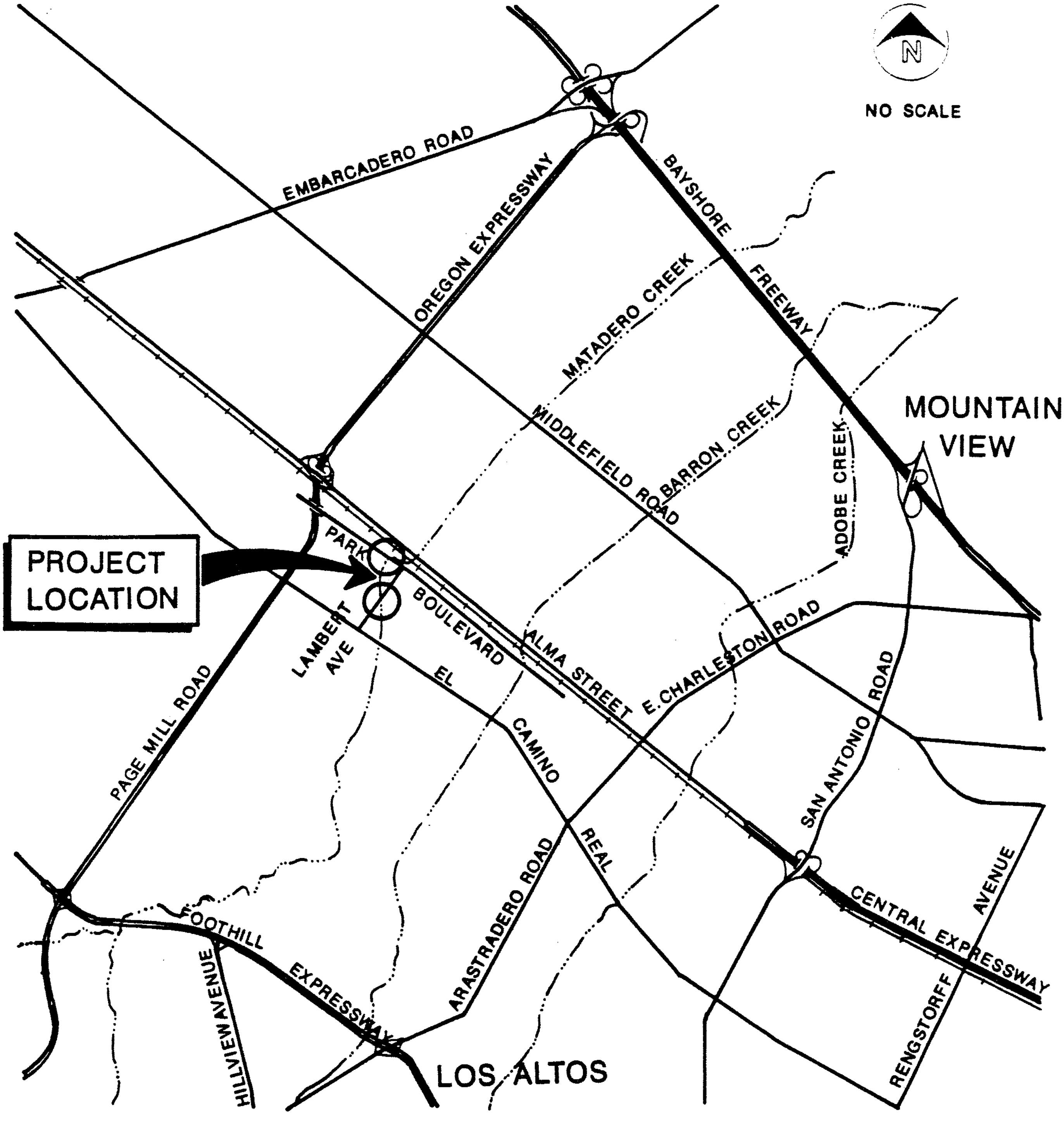


FIGURE 1
PROJECT LOCATION
MATADERO CREEK BRIDGES
PALO ALTO, CALIFORNIA

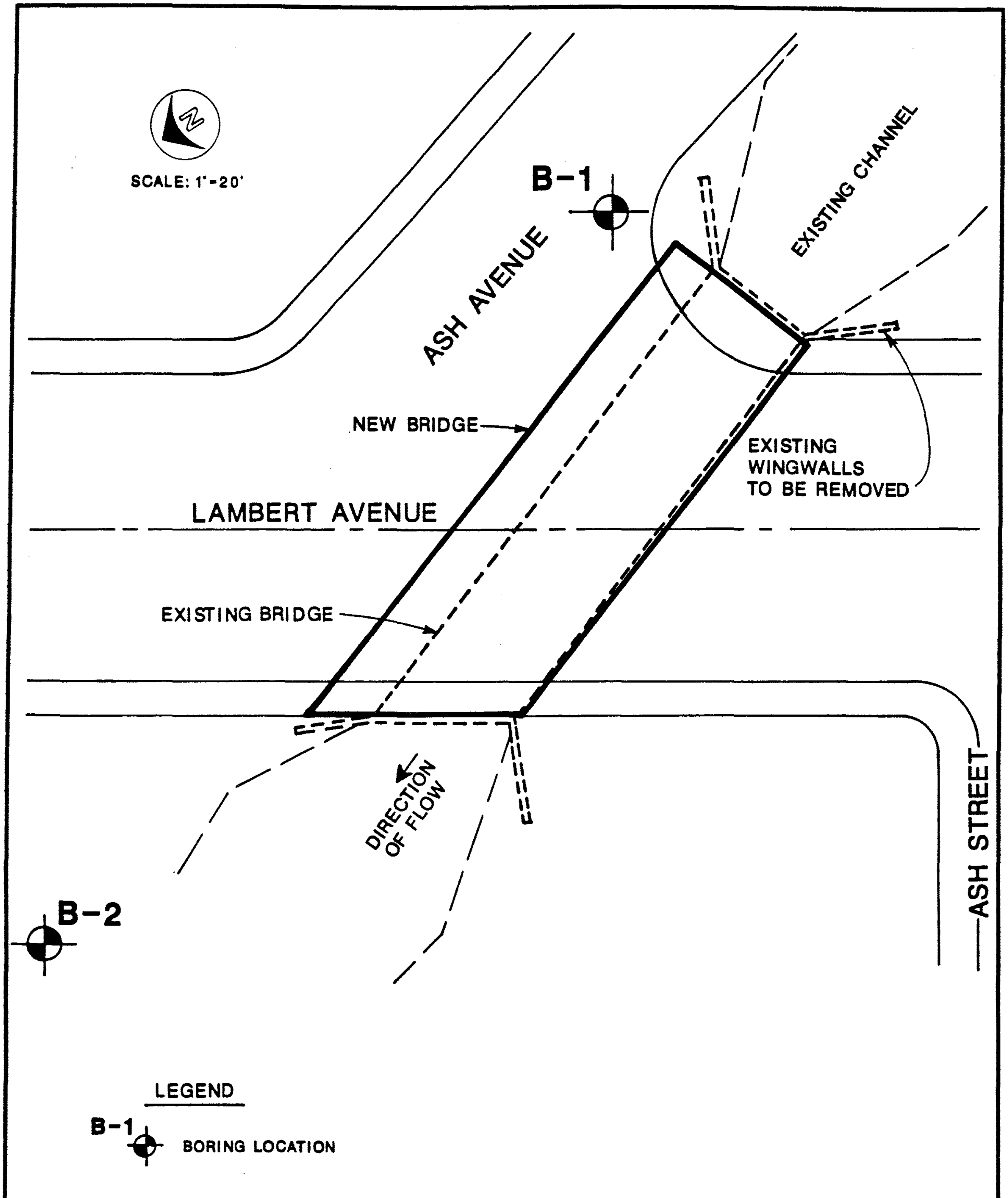
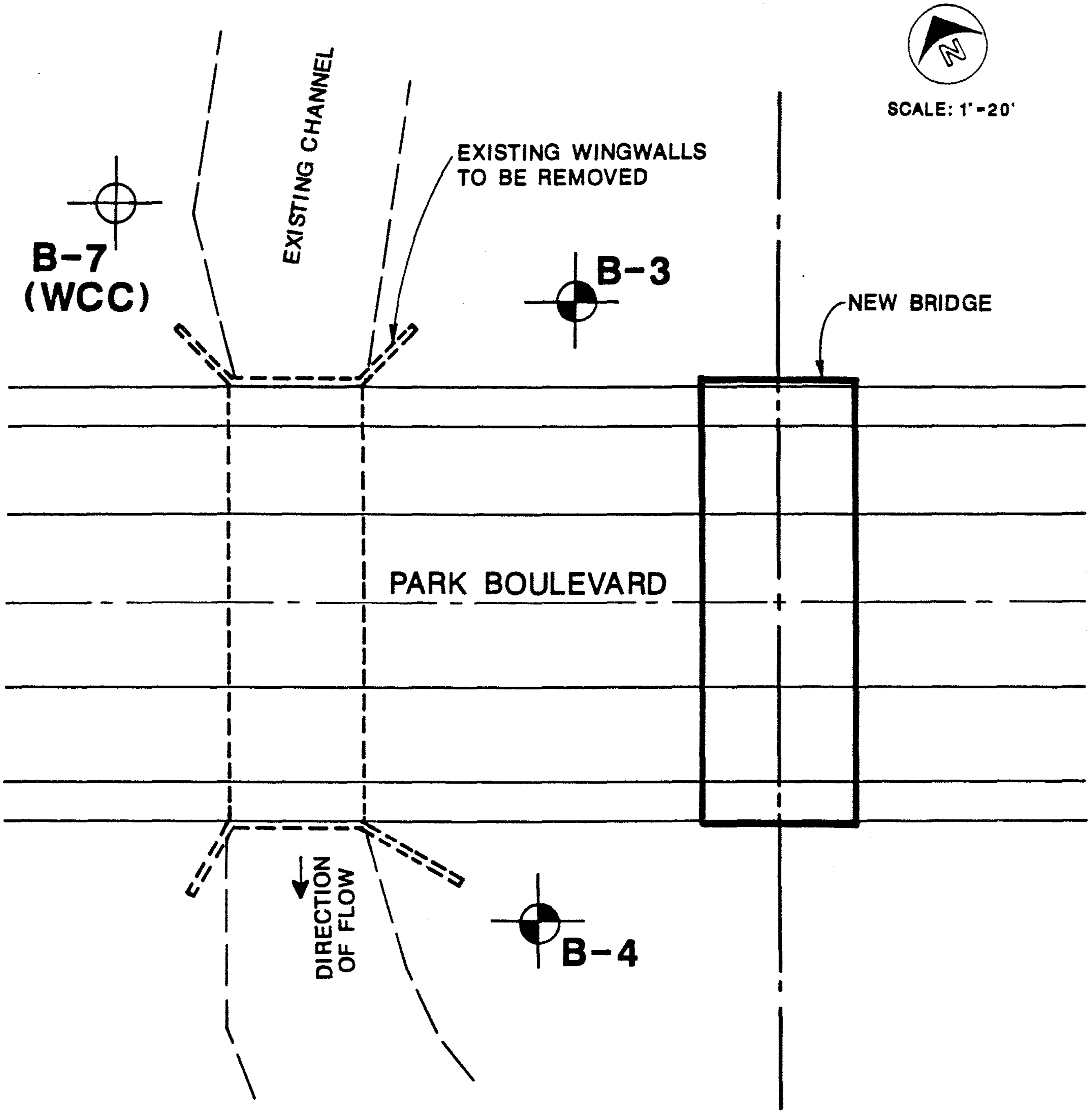


FIGURE 2
BORING LOCATIONS- LAMBERT AVE
MATADERO CREEK BRIDGES
PALO ALTO, CALIFORNIA



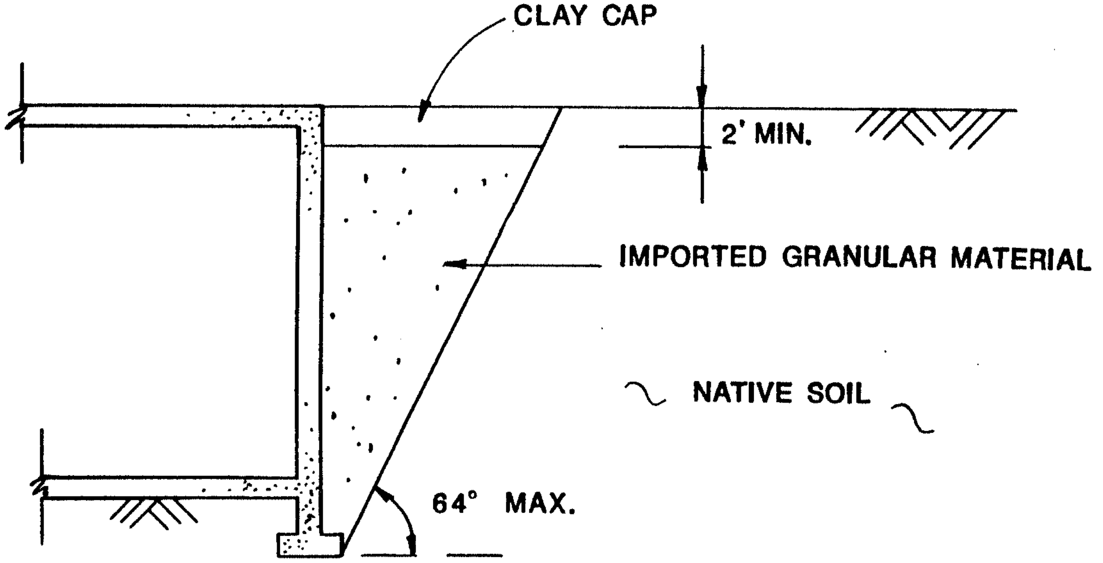
LEGEND

B-1 ⊕ BORING LOCATION

B-1 ⊕ BORING DONE BY OTHERS, LOCATION APPROXIMATE

(WCC) WOODWARD CLYDE CONSULTANTS

FIGURE 3
BORING LOCATIONS- PARK BLVD
MATADERO CREEK BRIDGES
PALO ALTO, CALIFORNIA



NO SCALE

FIGURE 4
IMPORTED BACKFILL CONFIGURATION
MATADERO CREEK BRIDGES
PALO ALTO, CALIFORNIA

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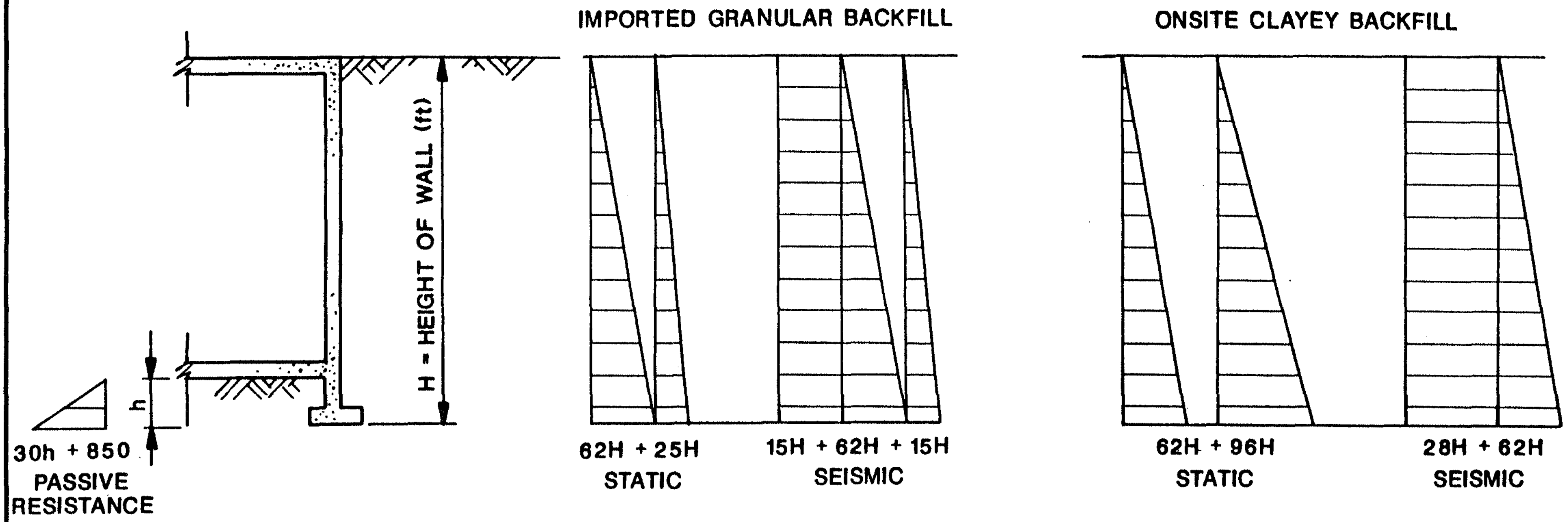

NOTE:

1. FOR A GIVEN BACKFILL MATERIAL, CHOOSE THE LARGER OF THE STATIC OR SEISMIC LOADING FOR DESIGN.
2. ALL UNITS ARE POUNDS PER SQUARE FOOT PER HEIGHT OF WALL
3. NO SCALE

FIGURE 5
LATERAL EARTH PRESSURE SUMMARY
MATADERO CREEK BRIDGES
PALO ALTO, CALIFORNIA

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APPENDIX A
BORING LOGS FROM PREVIOUS EXPLORATIONS

Project: MATADERO CREEK FLOODWALLS
Palo Alto, California

Log of Boring No. 7

Date Drilled: AUGUST 18, 1988
Type of Boring: Rotary Wash
Hammer: 140 lbs.

Remarks:Park City LeasingProperty, east end of site
Approx. 8 Ft. from channel lining
Location:

Surface Elevation: 28.0 ±

Depth Ft.	Samples	Blows/Ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density pcf	Unconfined Compress. Strength, psf
			3" ASPHALTIC CONCRETE 9"AGGREGATE BASE			
	1	37	SILTY CLAY FILL (CL) Moderately compacted, brown, some fine sand damp	14	100	2430
5	2	19	SILTY CLAY (CL-CH) Stiff, moist, dark brown, rootlets, trace fine sand	32	86	1540
10	3	35	SANDY CLAY, (CL) Very stiff, moist, brown, occasional gravel	24	100	3730
15	4	31	CLAYEY SAND (SC) Medium dense, brown, some gravel	25	99	710
			SANDY CLAY (CL) Stiff to very stiff, brown, some gravel			
20	5	21	SILTY CLAY.(CL) Stiff, brown, occasional fine gravel, carbonate deposits	24	98	2990
25	6	87	SANDY GRAVEL (GW) Dense, brown, some clay binder, gravel to 1" diameter			
30	7	23	SILTY CLAY (CL) Stiff to very stiff, brown, some sand, carbon staining	24	101	3290
			BOTTOM OF BORING AT 31-1/2 FEET			
35						
40						

Project: 8810070-R Woodward-Clyde Consultants Figure 9

APPENDIX B
BORING LOGS FOR CURRENT PROJECT

PROJECT NUMBER SF027979.BB.10
BORING NUMBER B-1
SHEET 1 **OF** 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** LAMBERT AVE.- UPSTREAM ABUTMENT
ELEVATION: ~ 31' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES
DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.
WATER LEVEL AND DATE: ~ 17' 7/5/89 **START:** 7/5/89 **FINISH:** 7/5/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
0					3" Asphalt paving Aggregate Base: Silty, sandy gravel, ~ 3/4" minus ▽From Cuttings: CLAY W/ FINE SAND, stiff, plastic, moist, black (CH)	HNU=0.6ppm (Background) Cuttings: HNU=0.6ppm Breathing Zone=0.6ppm Hole=0.6ppm
5	5.0 6.5	SS-1	12"	4 - 8 - 12 (20)	CLAY W/ FINE SAND, very stiff to hard, plastic, moist, dark brown (CH) From Cuttings: Similar, but darker color	HNU=0.6ppm PPT=2.7 TSF Down - Hole Hammer used for all driven samples
10	10.0 11.5	CS-1	18"	5 - 10 -11	Top 6": CLAY W/ FINE SAND, very stiff to hard , plastic w/ some coarse sand and fine gravel, moist, dark brown (CH) Bottom 12": Distinct horizon of CLAY W/ SOME COARSE SAND AND FINE GRAVEL, friable, light greenish - grey w/ some rust mottling, very stiff to hard (CH)	HNU=0.6ppm PPT=2.75 - 3.4 TSF PPT=3.2 - 3.8 TSF Fractures under PPT Driller reports firmer material at ~ 13.5'
15	15.0					

PROJECT NUMBER SF027979.BB.10	**BORING NUMBER** B-1	**SHEET** 2 **OF** 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** LAMBERT AVE.- UPSTREAM ABUTMENT

ELEVATION: ~ 31' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.

WATER LEVEL AND DATE: ~ 17' 7/5/89 **START:** 7/5/89 **FINISH:** 7/5/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
15	15.0 16.5	SS-2	18"	8 - 9 - 9 (18)	CLAYEY SAND AND GRAVEL, well - graded sand to ~ 1/2" minus gravel, w/ a few pockets of uniform fine sand, loose, moist (SC - GC)	HNU=0.6ppm - Hole, Cuttings, Sample, and Breathing Zone
	16.5 17.5				SANDY GRAVEL W/ FEW FINES, well graded subangular, two - 2" minus gravel particles in sampler, loose, brown, (GW)	
	17.5 19.0	CS-2	18"	9 - 14 - 14		2" rock in tip of sampler - blow counts questionable HNU=0.6ppm
	19.0 20.0					
20	20.0 21.5	SS-3	18"	6 - 10 - 10 (20)	Similar SANDY GRAVEL, moderately denser	HNU=0.6ppm
	21.5 25.0					Driller advances auger at low rpm driller notes similar conditions
25	25.0 26.5	SS-4	16"	2 - 4 - 4 (8)	SILTY CLAY W/ FINE SAND, very stiff, moderately plastic, w/ some medium to coarse sand, light brown w/ some rust mottling (CL)	HNU=0.6ppm PPT=0.9 - 1.5 TSF Note: Catcher installed
	26.5 28.5	ST-1	24"	PUSHED	Shelby Tube: Tip material similar to SS-4	Easy push in first 9", steady 75 psi + or - down pressure to 24"
	28.5 30.0					PPT= 1.25 TSF TV= 3.4 TSF
30						

PROJECT NUMBER SF027979.BB.10	**BORING NUMBER** B-1 **SHEET** 3 **OF** 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** LAMBERT AVE.- UPSTREAM ABUTMENT

ELEVATION: ~ 31' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.

WATER LEVEL AND DATE: ~ 17' 7/5/89 **START:** 7/5/89 **FINISH:** 7/5/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
30	30.0 31.5	SS-5	18"	4 - 7 - 15 (22)	Top 12": SANDY CLAY, stiff to very stiff, medium plastic, mostly fine sand w/ some pockets of CLAYEY FINE SAND, some gravel particles, dense, moist, greenish - grey W/ SOME RUST MOTTLING. ~ 2" Thick Sandy Gravel Seam, few fines. Bottom 6": SANDY CLAY, stiff, plastic, mostly fine sand but w/ some coarse, also w/ some friable dark brown /black particles (coarse sand size) dark grey, moist (CL)	HNU=0.6ppm Rock in tip of sampler blow counts questionable PPT=0.9 - 1.6 TSF
35	35.0 36.5	SS-6	12"	6 - 16 - 22 (36)	CLAYEY SAND AND GRAVEL, well - graded, subangular, wet, moderately plastic fines, medium dense, brown (SC)	HNU=0.6ppm Note: Catcher installed
40	40.0 41.5	SS-7	4"	19 - 10 - 14 (24)	SANDY GRAVEL, well graded, subangular, with few fines, wet, brown (GW)	1" minus rock in catcher blow counts suspect HNU=0.6ppm on Sample, Cuttings, Breathing Zones
						Hole abandoned by tremied grout (neat cement)
45						

PROJECT NUMBER	BORING NUMBER	
SF027979.BB.10	B-2	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** LAMBERT AVE. - DOWN STREAM ABUTMENT

ELEVATION: ~ 31' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 I.D. H.S.A.

WATER LEVEL AND DATE: ~ 17' 7/5/89 **START:** 7/7/89 **FINISH:** 7/7/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
0					Surface: 3/4" minus gravel	HNW=0.3ppm (Background)
					Cuttings: SANDY CLAY WITH SOME GRAVEL, dry, brown (CL)	
					Cuttings: Similar , but moister & darker, alternating with more gravelly sandy clay	
						Firmer at 3.5' Gravelly at 4.0'
5	5.0 6.5	SS-1	14"	11 - 12 - 15 (27)	SANDY CLAY, hard , fine to medium sand moist, dark brown to black (CH)	HNU=0.3ppm PPT=>4.5 TSF Down - Hole Hammer used for all driven samples
					Cuttings: Similar	
10	10.0 11.5	SS-2	18"	5 - 7 - 8 (15)	CLAY WITH SOME FINE SAND, hard, plastic, brown (CH)	HNU=0.3ppm PPT=3.5 - >4.5 TSF
15	15.0					

PROJECT NUMBER SF027979.BB.10
BORING NUMBER B-2
SHEET 2 **OF** 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** LAMBERT AVE. - DOWN STREAM ABUTMEN
ELEVATION: ~ 31' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES
DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 I.D. H.S.A.
WATER LEVEL AND DATE: ~ 17' 7/5/89 **START:** 7/7/89 **FINISH:** 7/7/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
15	15.0 16.5	ST-1	18"	PUSH	Similar	
	16.5 18.5	SS-3	18"	2 - 3 - 3 (6)	SILTY CLAY WITH FINE SAND, medium plasticity, firm to stiff, marginally friable, brown with grey (CL)	WL~ 17' PPT=0.3 - 0.8 TSF Driller reports similar drilling conditions
	18.5 20.0					
20	20.0 21.5	SS-4	15"	3 - 4 - 6 (10)	CLAY WITH SOME SILT AND FINE SAND, plastic, stiff, with some pockets of fine sand, brown (CL-CH)	PPT=0.8 - 1.2 TSF
	21.5 25.0					
25	25.0 26.5	ST-2	20"	PUSHED	NOTE: TIP MATERIAL MAY NOT BE REPRESENTTIVE OF TUBE: SILTY CLAY WITH SOME FINE SAND stiff, plastic, brown (very soft, grey clay on outside of tube)	TV=5.8 TSF, PPT=1.2 TSF
	26.5 28.0	SS-5		3 - 4 - 4 (8)	CLAY WITH SOME SILT AND FINE SAND, firm to stiff, plastic, brown with grey, Sat. (CH)	PPT= 0.5 - 1.6 TSF
	28.0 30.0					
30						

PROJECT NUMBER SF027979.BB.10
BORING NUMBER B-2
SHEET 3 **OF** 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** LAMBERT AVE. - DOWN STREAM ABUTMEN

ELEVATION: ~ 31' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 I.D. H.S.A.

WATER LEVEL AND DATE: ~ 17' 7/5/89 **START:** 7/7/89 **FINISH:** 7/7/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
30	30.0 31.5	SS-6	15"	10 - 15 - 13 (28)	CLAYEY SAND AND GRAVEL, well graded, dense, saturated, brown (SC-GC)	HNU=0.3 ppm
						Driller reports similar conditions
35	35.0 36.5	SS-7	18"	12 - 20 - 22 (42)	SAND AND SANDY GRAVEL, grades from a fine and medium sand to gravel, few fines, dense, brown, subangular (SW-GW)	HNU=0.2 ppm
40	40.0 41.5	SS-8	18"	6 - 9 - 14 (23)	CLAY WITH SOME SAND, stiff, brown (CH) grading to a SANDY CLAY, then to a SAND WITH SOME CLAY, fine to medium, dense, dark grey	HNU=0.3ppm
						Hole abandoned with tremied grout
45						

PROJECT NUMBER	BORING NUMBER	
SF027979.BB.10	B-3	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** PARK BLVD. - DOWN STREAM ABUTMENT
ELEVATION: ~ 28' NVGD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES
DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.
WATER LEVEL AND DATE: ~ 20' 7/6/89 **START:** 7/6/89 **FINISH:** 7/6/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
0					Surface debris, weeds, concrete chunks, broken glass From Cuttings: Clayey sand with some gravel, loose, moist, dark brown (Fill)	HNU=0.4ppm (Background) Cuttings: HNU=0.4ppm Cuttings: HNU=0.4ppm
					Cuttings: Similar, but grading darker and moister	
5	5.0	SS-1	18"	2 - 2 - 4 (6)	SANDY CLAY AND CLAYEY SAND WITH SILT, mostly fine sand, moist, friable, brown with some rust mottling (CL-SC)	HNU=0.4ppm HNU=0.3ppm (Hole)
	6.5					
						Driller reports increased gravel ~8'
					From Cuttings: SANDY CLAY, very stiff, plastic, moist, black, fine to medium sand (CH)	Driller reports increased clay content, stiffer clay at ~9.5'
10	10.0	SS-2	18"	14 - 17 - 24 (41)	CLAYEY SAND WITH GRAVEL, loose, moist, plastic fines, subangular, brown, well graded (SC-GC)	HNU=0.3ppm Note: Piece of gravel in sampler may have increased blow counts
	11.5					
						Driller reports clayey sand and gravel with increased gravel with depth to ~14'. Changing to a Silty Clay ~14.5'
15	15.0					

PROJECT NUMBER	BORING NUMBER	
SF027979.BB.10	B-3	SHEET 2 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** PARK BLVD. - DOWN STREAM ABUTMENT
ELEVATION: ~ 28' NVGD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES
DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.
WATER LEVEL AND DATE: ~ 20' 7/6/89 **START:** 7/6/89 **FINISH:** 7/6/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
15	15.0 16.75	ST-1		PUSH	SILTY CLAY WITH FINE SAND, stiff to very stiff, plastic, friable, light brown (CL)	TV=3.0 TSF PPT=1.0 - 1.3 TSF Pushed shelby tube 21" used low down pressure (No gage reading)
	16.75 18.25	SS-3	18"	2 - 3 - 3 (6)	SILTY CLAY WITH FINE SAND, stiff to very stiff, plastic, moist, light brown, with some rust mottling (CL)	PPT=1.0 - 1.8 TSF HNU=0.4ppm
	18.25 20.0				Similar	
20	20.0 21.5	CS-1	18"	3 - 3 - 5	CLAY AND SILTY CLAY WITH FINE SAND, plastic to medium plastic, stiff, brown mottling. (CL to CH) with CLAY WITH SOME FINE SAND, stiff, plastic, light grey, saturated (CH)	Driller reports water level at ~20' PPT=0.5 - 0.9 TSF
	21.5 25.0				Similar	
25	25.0 26.5	ST-2	18"	PUSH	CLAYEY SILT, hard, friable, light brown, with fine sand, moderate plastic (CL-ML)	Max. down pressure over 3" - 4" 375 psi Avg. ~200 psi 18"-24" Note: Shelby tube could not be recovered - abandoned hole and moved 3' N.E. Drilled directly to 25 ft. to resume sampling
	26.5 28.0	SS-4	3"	4 - 4 - 5 (9)	Similar, CLAYEY SILT WITH FINE SAND, moderate plastic, friable, less hard, brown, moist (CL-ML)	HNU=0.4ppm PPT= 2.7 - 3.2 TSF
	28.0 30.0					
30						

PROJECT NUMBER	BORING NUMBER
SF027979.BB.10	B-3 SHEET 3 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** PARK BLVD. - DOWN STREAM ABUTMENT

ELEVATION: ~ 28' NVGD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.

WATER LEVEL AND DATE: ~ 20' 7/6/89 **START:** 7/6/89 **FINISH:** 7/6/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
30	30.0 31.5	ST-3	22"	PUSH	CLAY WITH SOME SILT, plastic, stiff, lighter brown, with fine sand (CL) SILTY CLAY WITH FINE SAND sand, plastic, stiff, moist, brown (CL)	TV=4.7 TSF, PPT= 2.0 TSF Pushed very easy Pushed at constant rate over 18" HNU=0.4ppm PPT=1.0 - 1.25 TSF DRiller reports easier drilling at 32.5'
35	35.0 36.5	SS-6	18"	4 - 6 - 7 (13)	CLAYEY SILT WITH FINE SAND, stiff, moderately plastic, friable, green - grey with rust mottling (CL-ML) grading to a SILTY SAND, dense, fine, moist, with similar coloring, low plasticity fines (SM)	PPT=1.0 - 1.8 TSF HNU=0.4ppm
40	40.0 41.5	SS-7		5 - 6 - 7 (13)	SILTY SAND, grades fine to medium, saturated, loose, dark greenish - grey (SM)	HNU=0.4ppm
						abandoned hole with tremied grout
45						

PROJECT NUMBER	BORING NUMBER	
SF027979.BB.10	B-4	SHEET 1 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** PARK BLVD.- UPSTREAM ABUTMENT

ELEVATION: ~ 28' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.

WATER LEVEL AND DATE: 20' 7/7/89 **START:** 7/6/89 **FINISH:** 7/7/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
0					Fill: SANDY, GRAVELLY CLAY, ~1" minus (access road)	HNU=0.3ppm (Background)
					Cuttings: SANDY CLAY, fine to medium sand, stiff, plastic, moist, black (CH)	
5	5.0 6.5	SS-1	18"	3 - 4 - 8 (12)	CLAY WITH SOME FINE SAND, stiff to very stiff, plastic, moist, black (CH)	HNU=0.4ppm PPT=1.3 - 1.6 TSF
					Similar cuttings, more brown than black	Driller reports seam of gravel at ~8.5'
10	10.0 11.5	SS-2	15"	6 - 9 -11 (20)	CLAYEY SAND WITH SOME GRAVEL, well graded, moist, brown, subangular, loose to medium dense (SC-GC)	HNU=0.3ppm HNU=0.3ppm (Cuttings)
					Similar, grading to CLAYEY GRAVEL Cuttings showing ~1" minus particles (GC)	Driller reports end of gravel ~14.5'
15	15.0					

PROJECT NUMBER	BORING NUMBER	
SF027979.BB.10	B-4	SHEET 2 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS LOCATION: PARK BLVD.- UPSTREAM ABUTMENT

ELEVATION: ~ 28' NGVD DRILLING CONTRACTOR: ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.

WATER LEVEL AND DATE: 20' 7/7/89 START: 7/6/89 FINISH: 7/7/89 LOGGER: L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
15	15.0 16.5	ST-1	18"	PUSH	SILTY CLAY WITH FINE SAND TO SANDY CLAY WITH SILT, fine sand, saturated, low to moderate plasticity, brown with some black mottling, stiff to very stiff (CL-ML)	HNU=0.4ppm (BG) Max down pressure 75 psi
	18.0	SS-3	18"	2 - 4 - 5 (9)	SITLY CLAY WITH SOME FINE SAND, plastic, moist, brown with rust mottling and some black spots, stiff to very stiff (CL)	HNU=0.3ppm TV=3.0 TSF, PPT=1.7 TSF PPT=1.6 - 1.9 TSF
20	20.0 21.5	ST-2	18"	PUSH	SILTY CLAY, soft, light brown with grey mottling, some hard carbonate particles saturated , somewhat blocky (CL)	Very easy push, firmer over 12" - 18"
	23.0	SS-4	18"	2 - 2 - 4 (6)	SILTY CLAY WITH SOME FINE SAND, stiff, plastic, with considerable fraction as hard carbonate particles (~10%), brown with light grey (CL)	PPT=0.9 - 1.2 TSF
						Driller reports similar material by ease of drilling
25	25.0 26.5	SS-5		5 - 7 - 7 (14)	SILTY CLAY WITH FINE SAND, stiff to very stiff, moderate plastic, brown with grey (CL)	PPT=1.3 - 1.7 TSF
						Driller reports firmer material at ~27'
30	30.0					

PROJECT NUMBER	BORING NUMBER	
SF027979.BB.10	B-4	SHEET 3 OF 3

SOIL BORING LOG

PROJECT: MATADERO CREEK BRIDGE IMPROVEMENTS **LOCATION:** PARK BLVD.- UPSTREAM ABUTMENT

ELEVATION: ~ 28' NGVD **DRILLING CONTRACTOR:** ENSCO ENVIRONMENTAL SERVICES

DRILLING METHOD AND EQUIPMENT: MOBIL B - 53 H.S.A.

WATER LEVEL AND DATE: 20' 7/7/89 **START:** 7/6/89 **FINISH:** 7/7/89 **LOGGER:** L. KROOK

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
30	30.0 31.5	SS-6	18"	3 - 3 - 3 (6)	SILTY CLAY WITH FINE SAND, firm to stiff, plastic, moist, some carbonate deposits, some small root holes, brown with some light grey and black mottling (CL)	PPT=0.4 - 1.0 TSF
35	35.0 36.5	SS-7	12"	9 - 7 - 16 (23)	SANDY CLAY grading to to CLAYEY SAND, fine sand, dense, wet, brown (SC) (Well graded sand as slough in sampler)	Aborted attempted shelby tube when material seemed to resist PUSH - Also ~1' of sand (assumed) came up into auger - confirmed a well-graded sand in tip of shelby tube
40	40.0 41.5	SS-8		8 - 7 - 13 (20)	SILT WITH SOME CLAY AND FINE SAND, stiff, with seams of fine to medium sand with few fines, dark grey, low to medium plasticity (CL)	
						Abandoned hole with tremied grout
45						

APPENDIX C
LABORATORY ANALYSES

Table C-1
LABORATORY TEST RESULTS
MATADERO CREEK BRIDGES
AT LAMBERT AVENUE AND PARK BOULEVARD

Sample No.	Soil Type	Depth	Natural Moisture Content (%)	Atterberg Limits			Sieve Analysis	Consolidation Test	Triaxial UU Shear Strength (tsf)
				Liquid Limit	Plastic Limit	Plasticity Index			
B-1 ST-1	CH	26.5-28.5	26.7	52	16	36			1.67
CS-2	GP	17.5-19.0	9.9				*		
SS-3	SM-SC	15.0-16.5	11.0				*		
SS-5	CL	30.0-31.5	19.4	35	16	20			
B-2 ST-1	CL	15.0-16.5	24.5,25.8	38	20	18		*	0.89
ST-2	CL	25.0-26.5	29.5	46	19	27			0.95
SS-4	CL	20.0-21.5	24.7	40	18	23			
B-3 CS-1	CL	20.0-21.5	38.3	46	17	29			
ST-1	CL	15.0-17.0	27.0	42	18	24			0.91
ST-2	CL	25.0-26.5	21.4	37	18	19			
ST-3	CL	30.0-31.5	27.5	49	19	30			1.04
B-4 ST-1	CL	15.0-16.5	27.3	36	19	17			0.79
ST-2	CH	20.0-21.5	27.5,34.5	57	18	40		*	0.85
SS-5	CL	25.0-26.5	23.7	41	17	24			
SS-6	CL	30.0-31.5	37.1	49	17	32			

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*See attached figures for test results.

Woodward-Clyde Consultants

GRAIN SIZE DISTRIBUTION CURVES

PROJECT NAME CH2M Hill (SFO 027979.BB.10) MC. Bridge PROJECT NO. 16871 A

TESTED BY Ted Berger 7/28/89 PLOTTED BY Ted Berger 7/28/89 REVIEWED BY C Wason 7/28/89

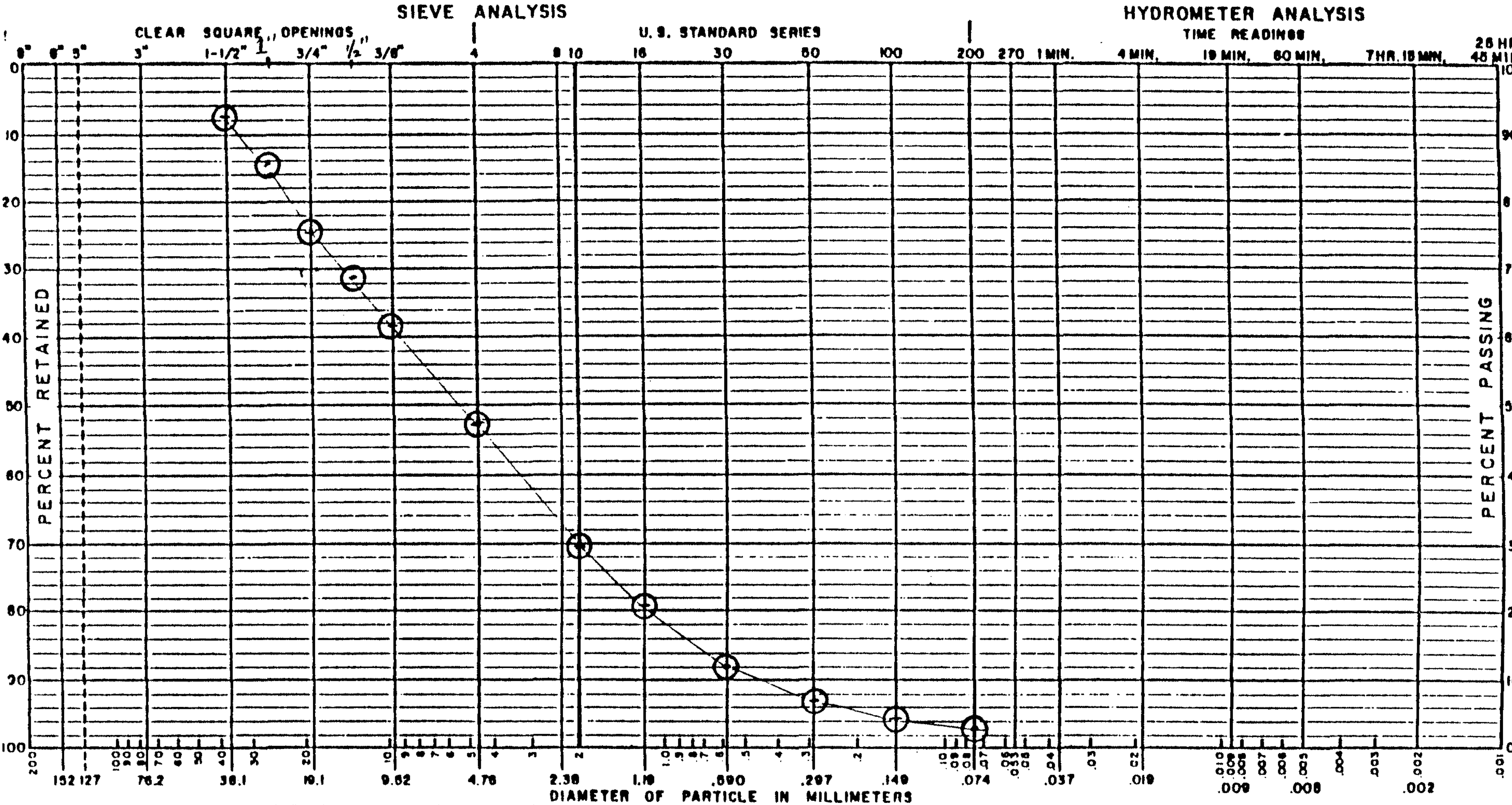
SAMPLE NO. B-1 SS-2 DEPTH 17.5' - 19' U.S.C.S. GP

LIQUID LIMIT ______ $D_{10\%}$ = 0.46 C_u = 20.2

PLASTICITY INDEX ______ $D_{30\%}$ = 2 C_c = ______

$D_{60\%}$ = 9.3

WELL GRADED	
GRAVEL	SAND
$C_u > 4$	$C_u > 6$
$C_c \geq 1 \leq 3$	$C_c \geq 1 \leq 3$



COBBLES	GRAVEL		SAND			CLAY (PLASTIC) TO SILT (NON-PLASTIC)
	COARSE	FINE	COARSE	MEDIUM	FINE	

Woodward-Clyde Consultants

GRAIN SIZE DISTRIBUTION CURVES

PROJECT NAME CH2M Hill (SFO 027979.BB.10) MC. Bridge PROJECT NO. 16871A

TESTED BY Ted Berger 7/28/81 PLOTTED BY Ted Berger 7/28/89 REVIEWED BY C. Wason 7/28/89

SAMPLE NO. B-1 SS-3 DEPTH ______ U.S.C.S. SM-SC

LIQUID LIMIT ______

PLASTICITY INDEX ______

$D_{10\%}$ = ______

$D_{30\%}$ = ______

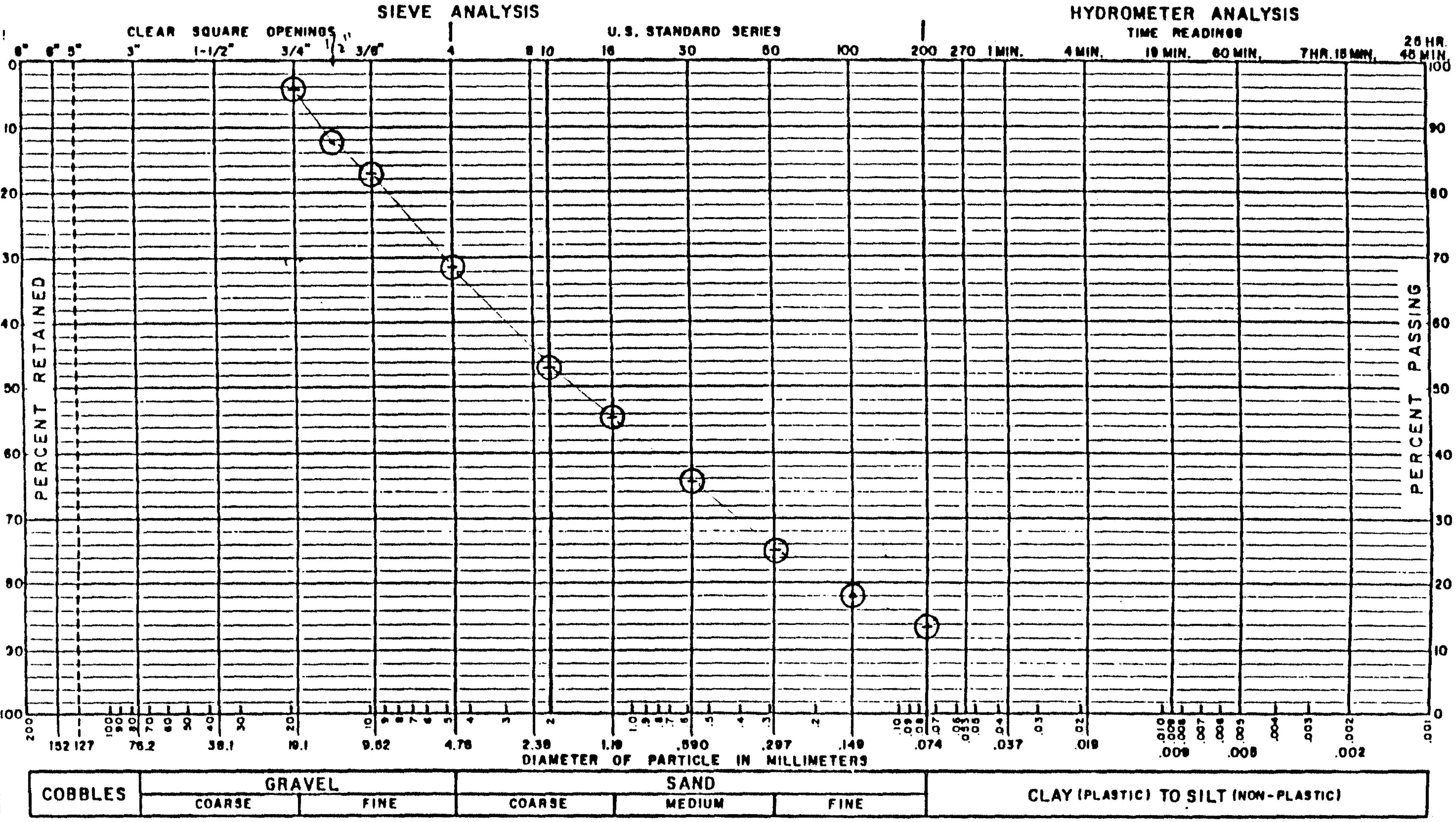
$D_{60\%}$ = ______

C_u = ______

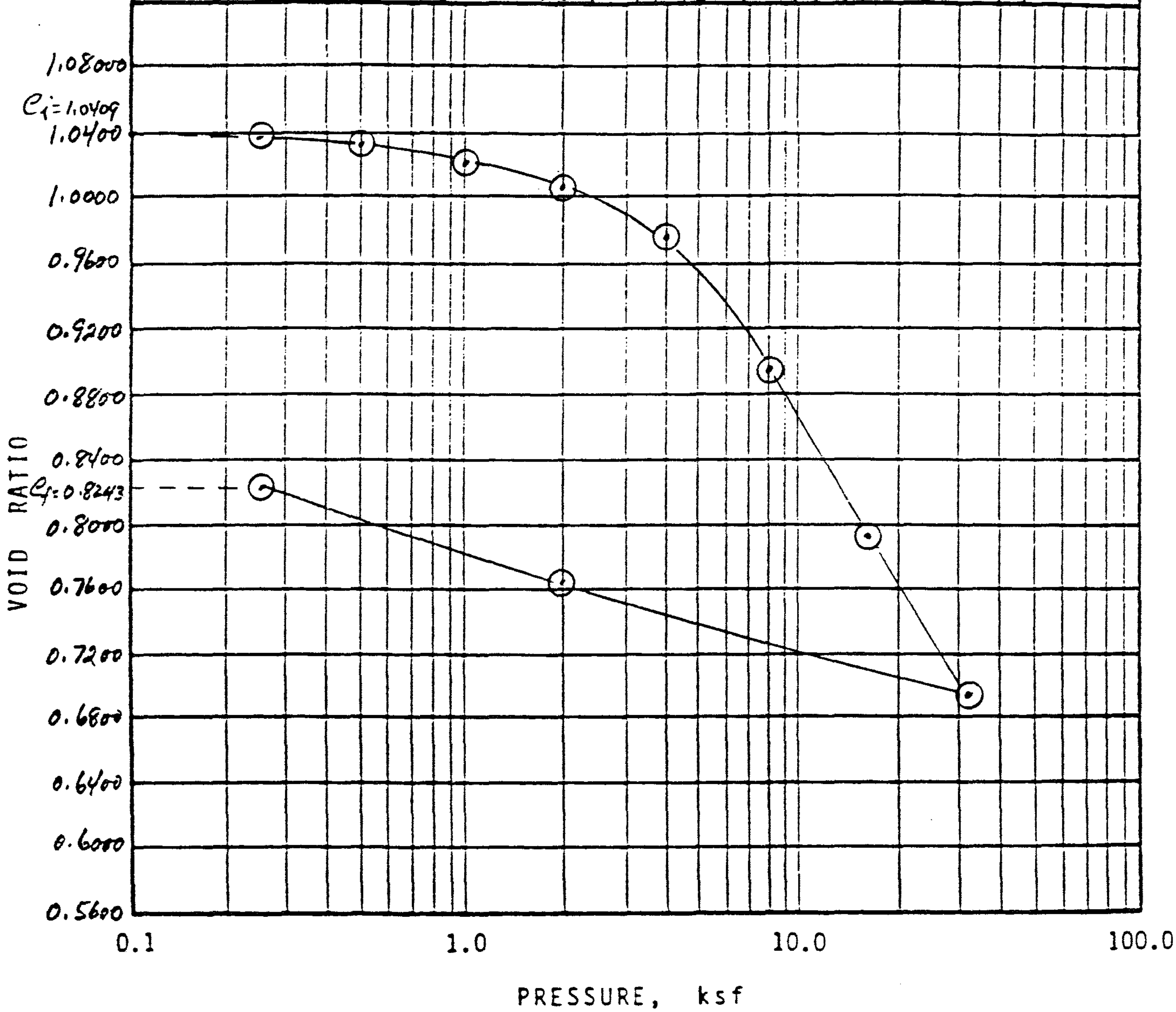
C_c = ______

WELL GRADED

GRAVEL	SAND
$C_u > 4$	$C_u > 6$
$C_c \geq 1 \leq 3$	$C_c \geq 1 \leq 3$



SAMPLE NO. B-4 ST-2 20 - 21.5	SUMMARY OF TEST RESULTS					
	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	ASSUMED	34.45	87.14	94.32	0.9273	2.43
FINAL	2.85	28.92	97.48	99.99	0.8289	



PROJECT NAME CH2M Hill (SF027979.BB.10) DATE 8-4-89

DESCRIPTION OF SAMPLE Lt. gray-brn w/ trace of organic silt & w/ calcium carbonated nodules CH TESTED BY C. Wason

REDUCED BY C. Wason

REMARKS CHECKED BY S. Capps

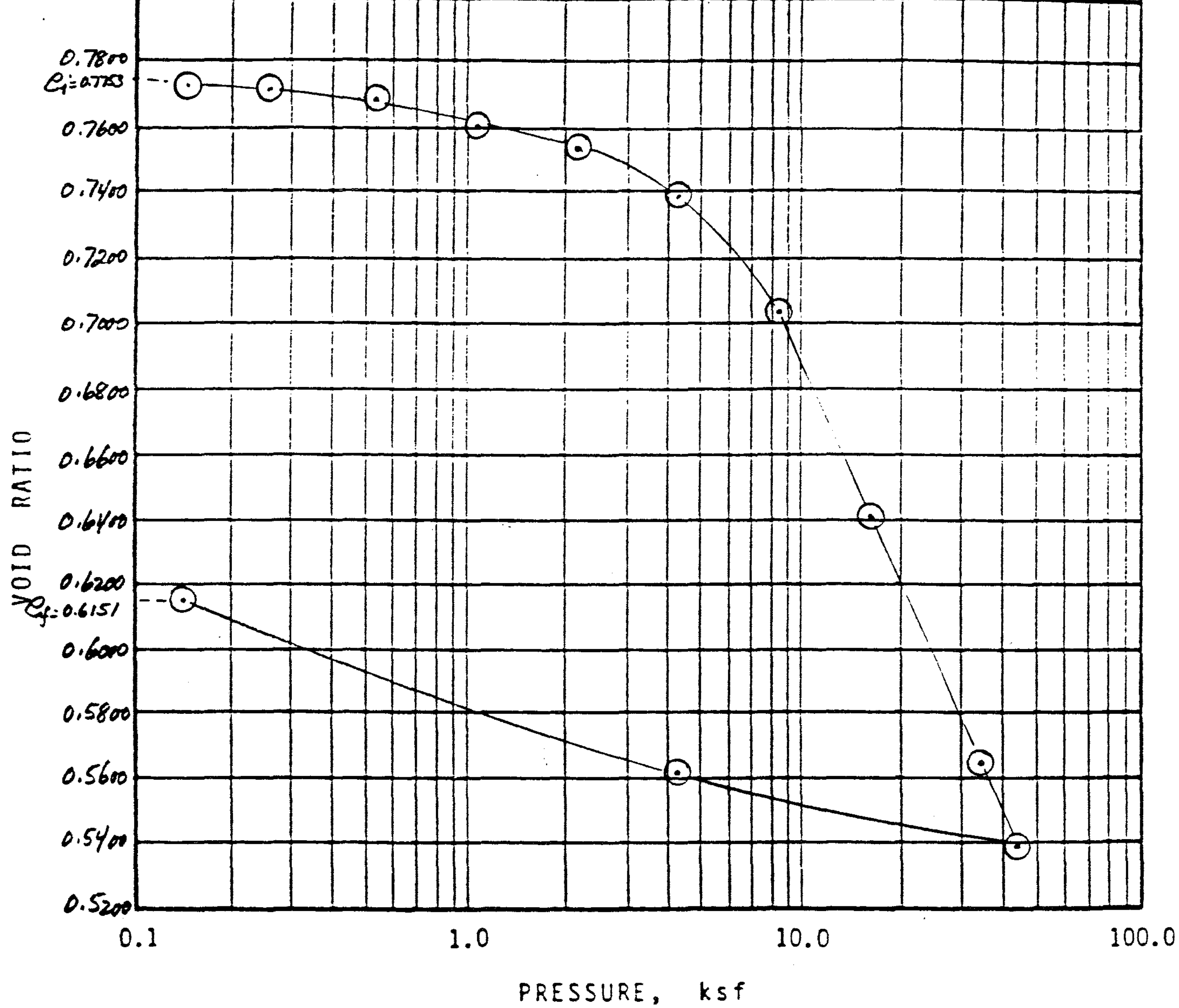
Project No. 16871A

Woodward-Clyde Consultants

CONSOLIDATION TEST RESULTS

FR.# 8

SAMPLE NO. B-2 ST-1 15-16.5	SUMMARY OF TEST RESULTS					
	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	ASSUMED	25.80	94.90	89.85	0.9275	2.43
FINAL	2.70	22.78	104.31	99.99	0.8438	



PROJECT NAME CH2M Hill (SF027979.BB.10) DATE 8-4-89
MATADERO CREEK BRIDGE

DESCRIPTION OF SAMPLE Grayish-brn si-clay TESTED BY C. Wason
CL w/ iron oxide staining REDUCED BY C. Wason

REMARKS CHECKED BY S. Capps

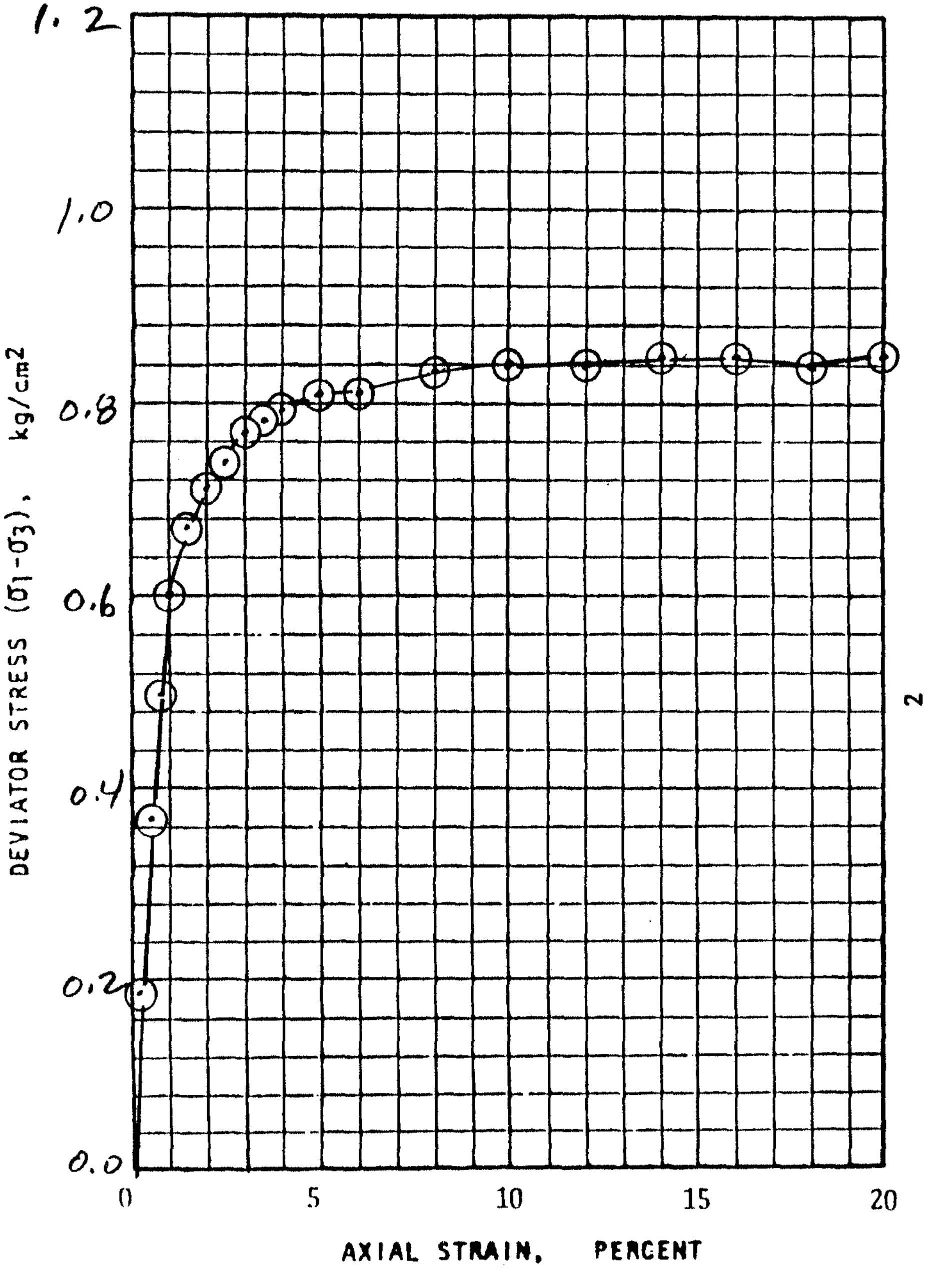
Project No. 16871A Woodward-Clyde Consultants	CONSOLIDATION TEST RESULTS	SOILTEST MODEL C-220

PROJECT NAME CH2M HILL M.C. BRIDGES PROJECT NO. 16871A DATE 8/1/89

SAMPLE NUMBER *B-4 ST-2* DESCRIPTION OF SAMPLE *LT BRN SILTY CLAY W/CALC. NODULES*

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps

RECEIVED
AUG 03 1989
CH2M HILL
SAN FRANCISCO

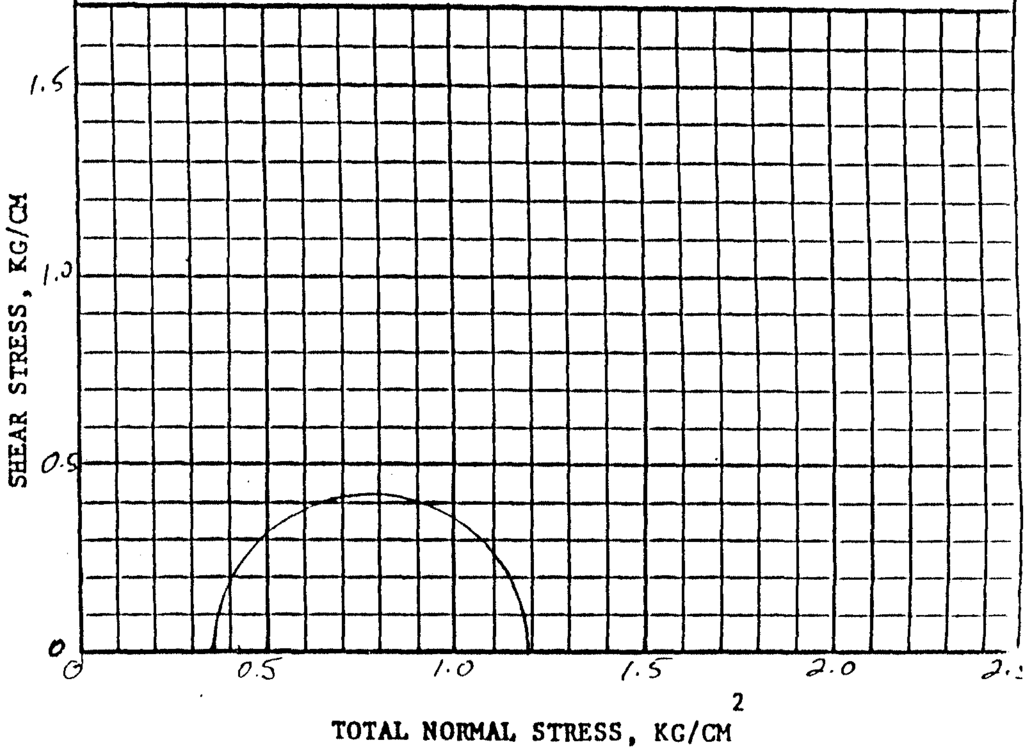


Depth: *20-21.5* ft.

TYPE OF SPECIMEN: Undisturbed X Remolded

TYPE OF TEST: Unconsolidated-Undrained Triaxial

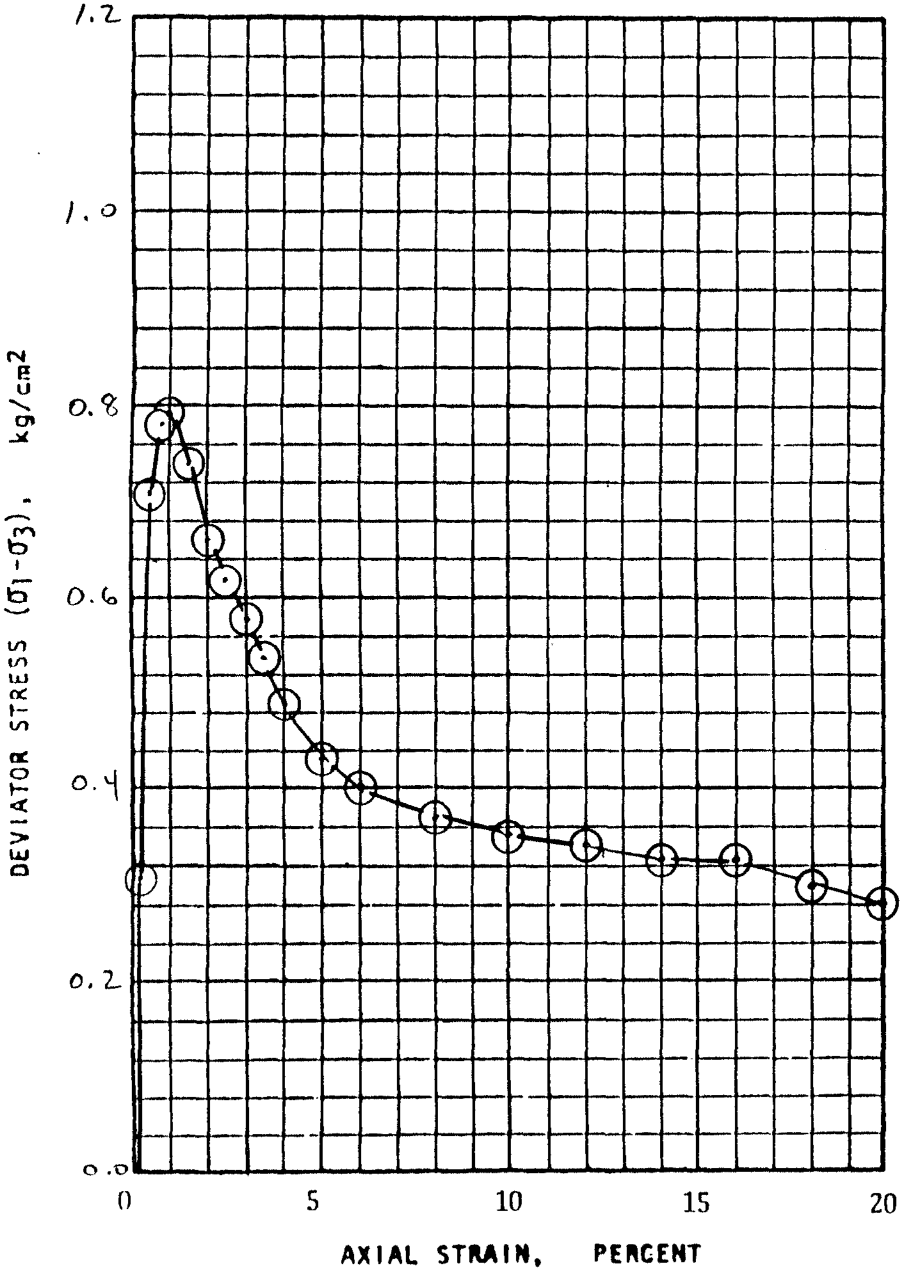
SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm²	DEVIATOR STRESS AT FAILURE kg/cm²	
	27.5	95.8	0.35	0.85	



PROJECT NAME CH2M HILL M.C. BRIDGES PROJECT NO. 10071A DATE 8/1/89

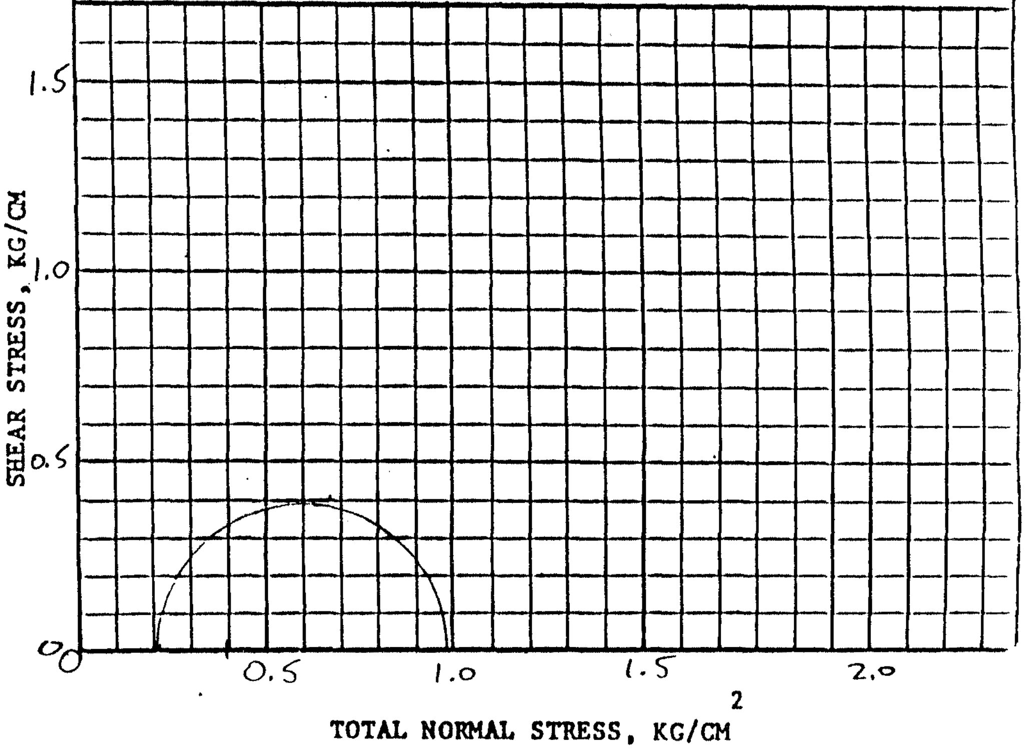
SAMPLE NUMBER B-4 ST-1 DESCRIPTION OF SAMPLE BRN FINE SANDY SILTY CLAY W/CALC. NOD.

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps



Depth: 15-16.5 ft.
TYPE OF SPECIMEN: Undisturbed X Remolded
TYPE OF TEST: Unconsolidated-Undrained Triaxial

SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm2	DEVIATOR STRESS AT FAILURE kg/cm2	
	27.3	94.4	0.21	0.79	

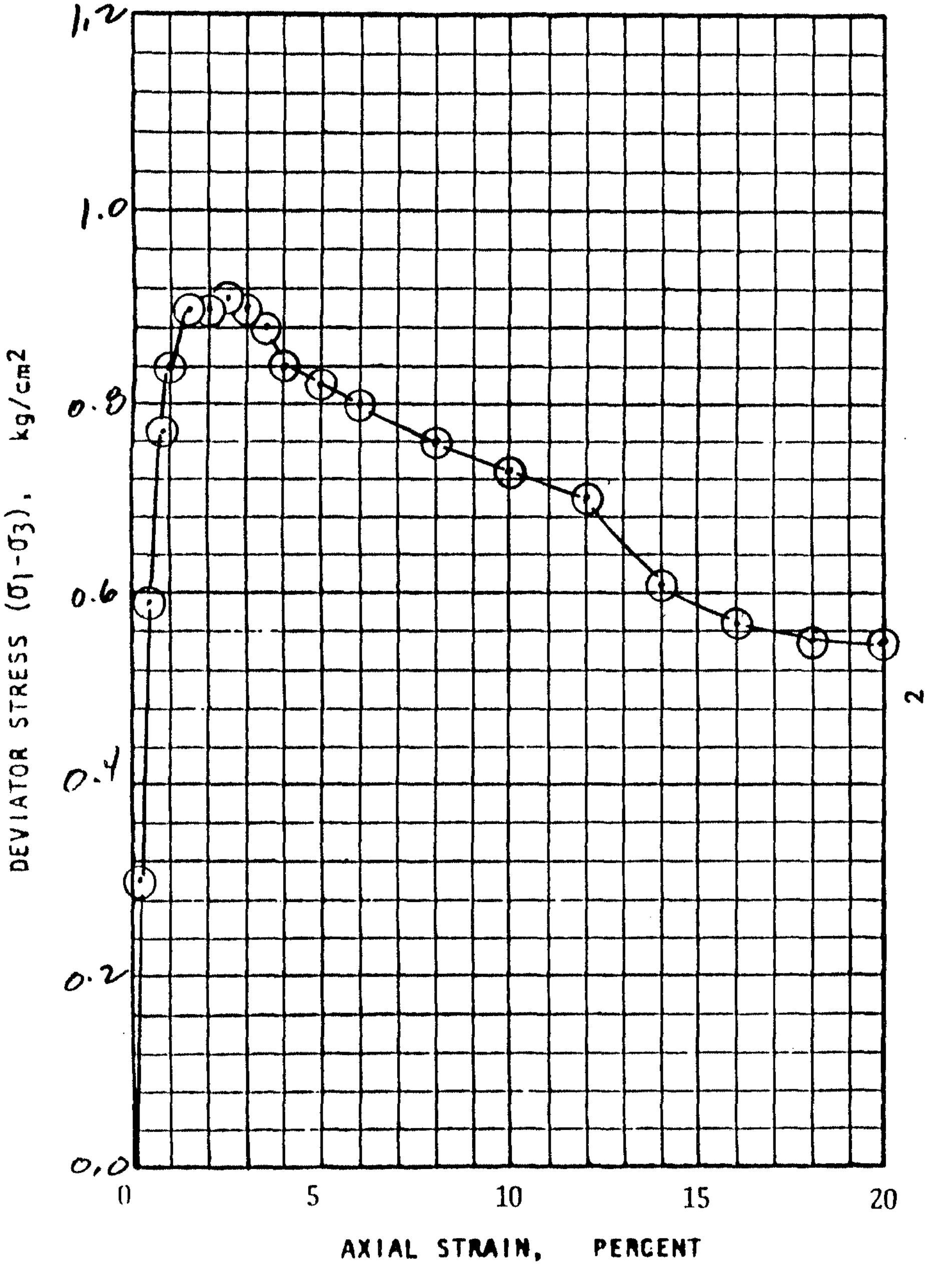


1

PROJECT NAME CH2M HILL M.C. BRIDGES PROJECT NO. 16871A DATE 8/1/89

SAMPLE NUMBER B-3 ST-1 DESCRIPTION OF SAMPLE BRN FINE SANDY SILTY CLAY

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps

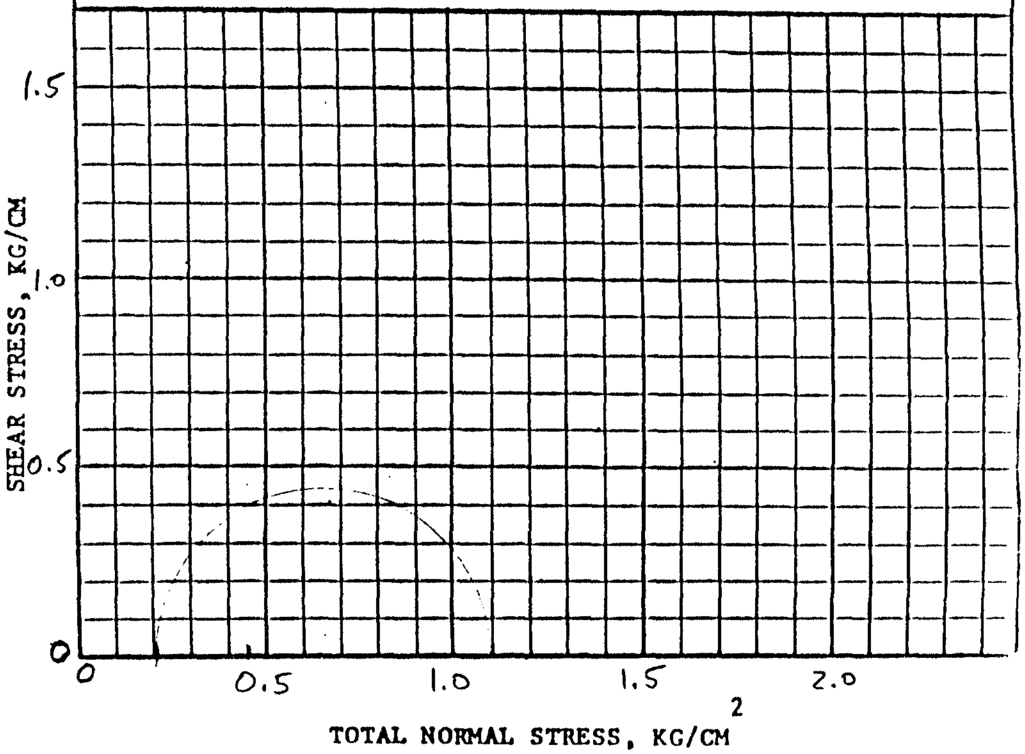


Depth: 15-17 ft.

TYPE OF SPECIMEN: Undisturbed X Remolded ___

TYPE OF TEST: Unconsolidated-Undrained Triaxial

SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm²	DEVIATOR STRESS AT FAILURE kg/cm²
	27.0	95.7	0.21	0.91

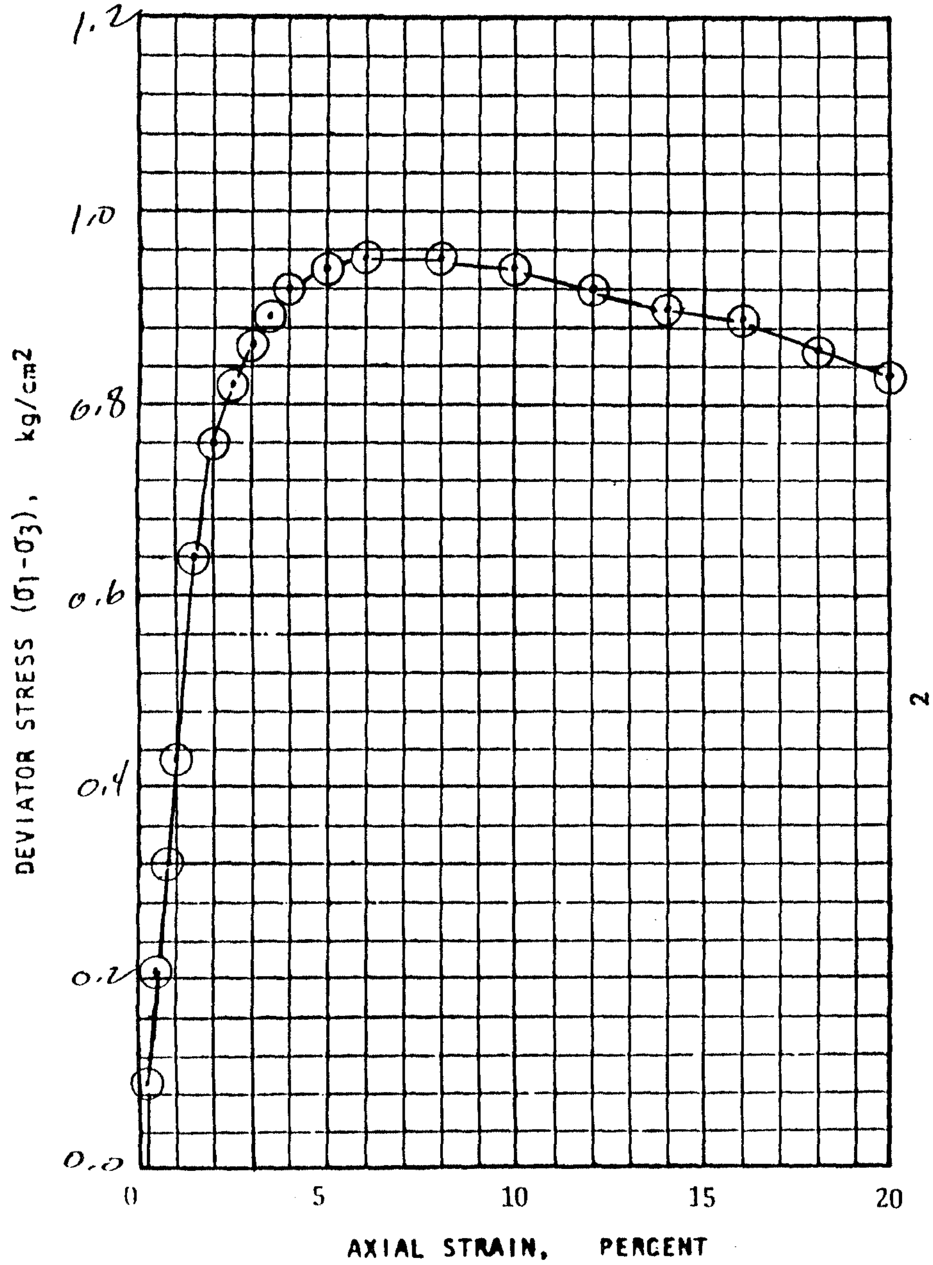


PROJECT NAME CH[illegible] ILL C. [illegible]GES PROJECT NO [illegible]687 DATE 8 [illegible]9

l

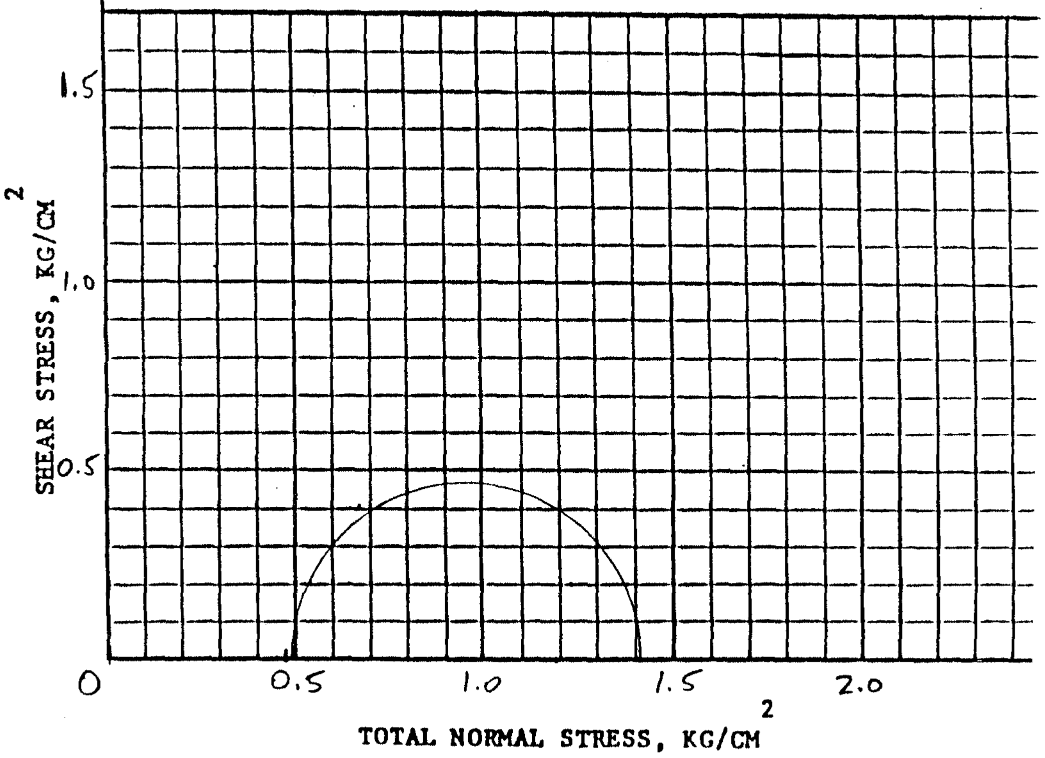
SAMPLE NUMBER *B-2 ST-2* DESCRIPTION OF SAMPLE *LT BRN Silty Clay w/Calc. Nodules*

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps



Depth: *25-26.5* ft.
TYPE OF SPECIMEN: Undisturbed X Remolded ____
TYPE OF TEST: Unconsolidated-Undrained Triaxial

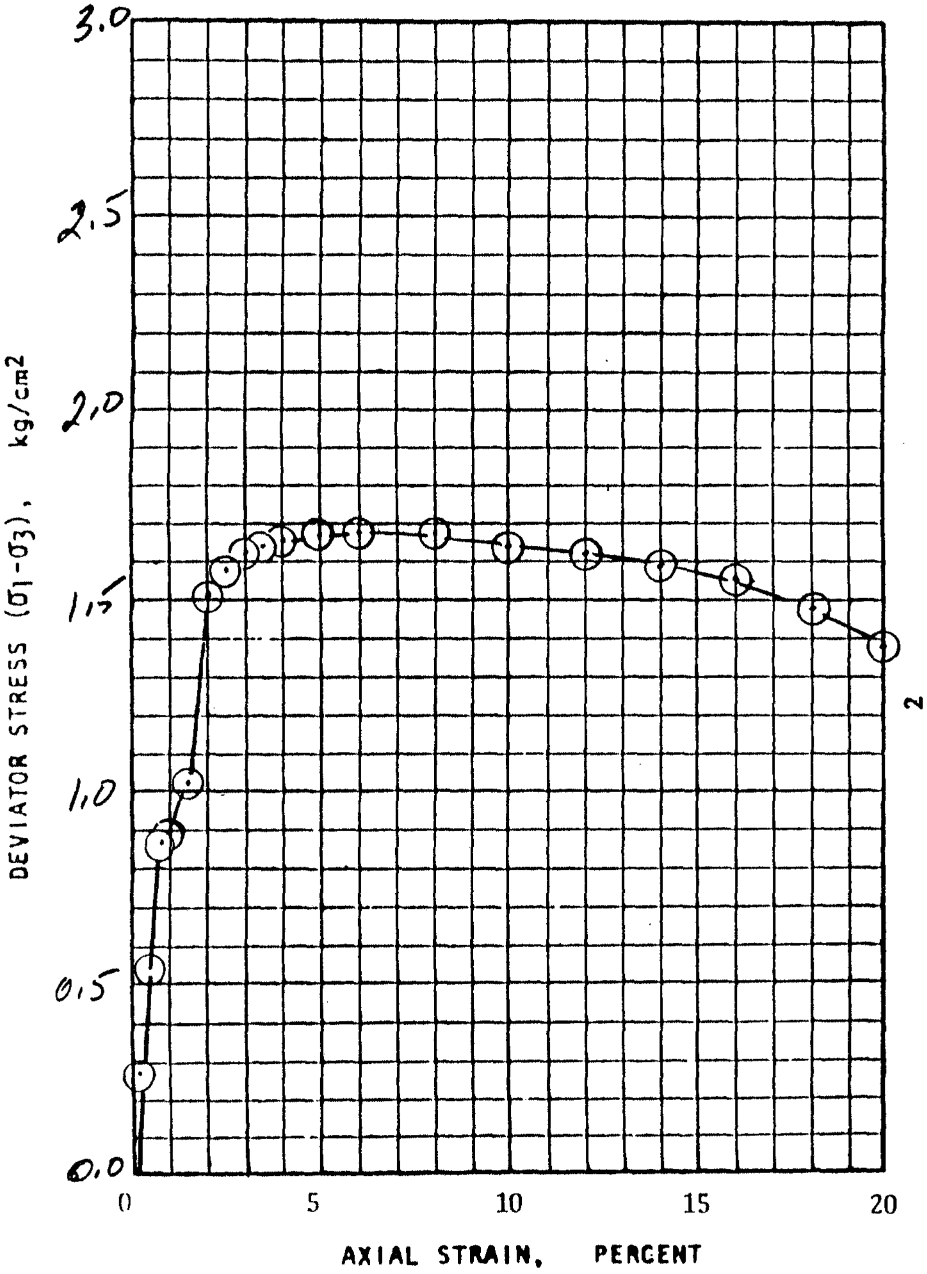
SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm²	DEVIATOR STRESS AT FAILURE kg/cm²	
	29.5	*92.8*	*0.49*	*0.95*	



PROJECT NAME CH2M HILL M.C. BRIDGES PROJECT NO. 16871A DATE 8/1/89

SAMPLE NUMBER B-1 ST-1 DESCRIPTION OF SAMPLE LT BRN SILTY CLAY W/ CALC. NODULES

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps

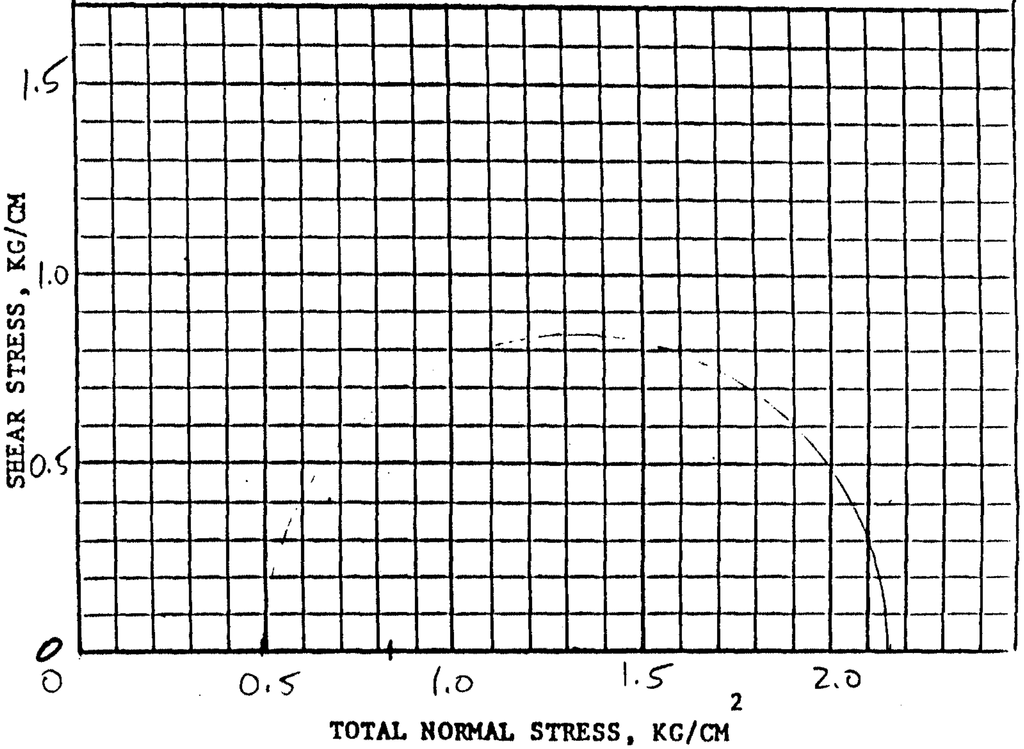


Depth: 26.5-28.5 ft.

TYPE OF SPECIMEN: Undisturbed X Remolded ____

TYPE OF TEST: Unconsolidated-Undrained Triaxial

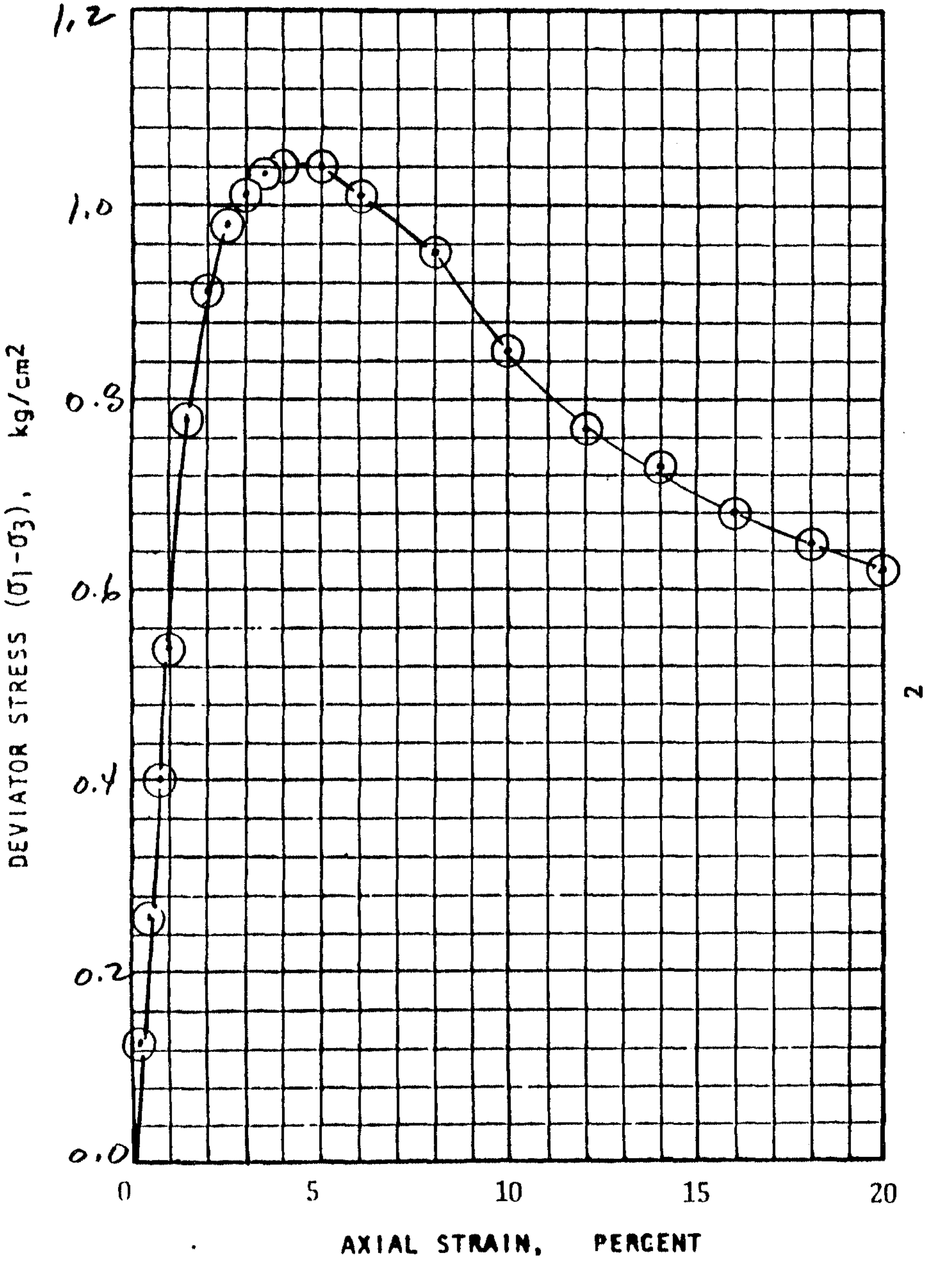
SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm^2	DEVIATOR STRESS AT FAILURE kg/cm^2	
	26.7	97.8	0.49	1.67	



PROJECT NAME CH2M HILL ..C. BRIDGES PROJECT NO. 871 DATE 8/1/

SAMPLE NUMBER B-3 ST-3 DESCRIPTION OF SAMPLE LT BRN SILTY CLAY w/CALC, NODULES

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps

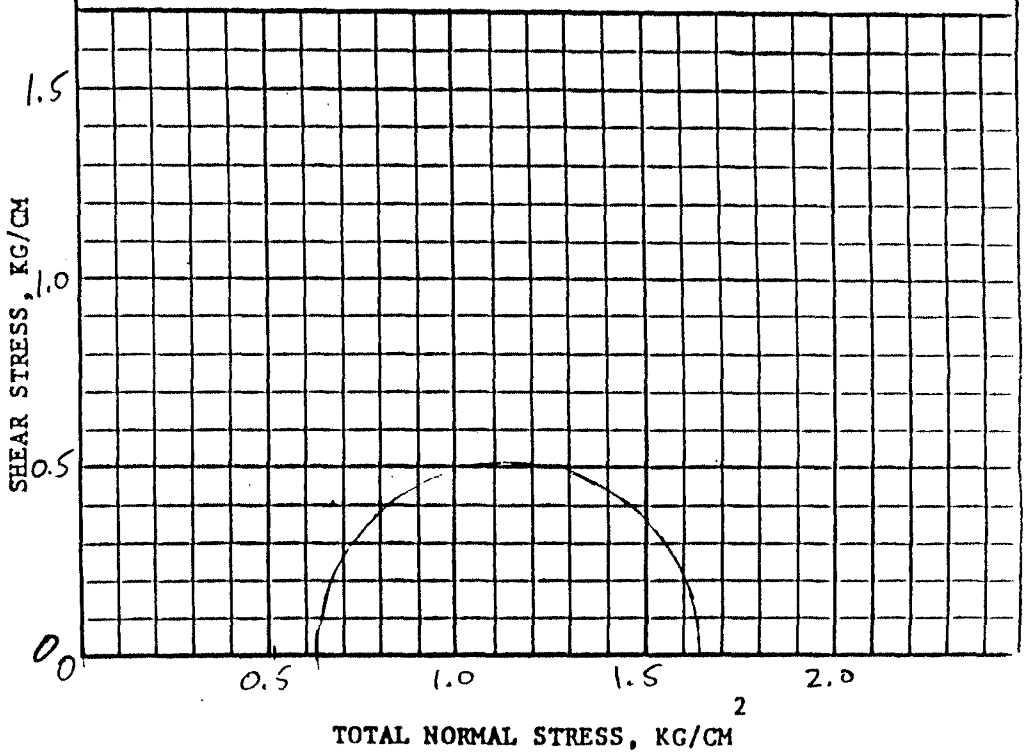


Depth: ft.

TYPE OF SPECIMEN: Undisturbed X Remolded

TYPE OF TEST: Unconsolidated-Undrained Triaxial

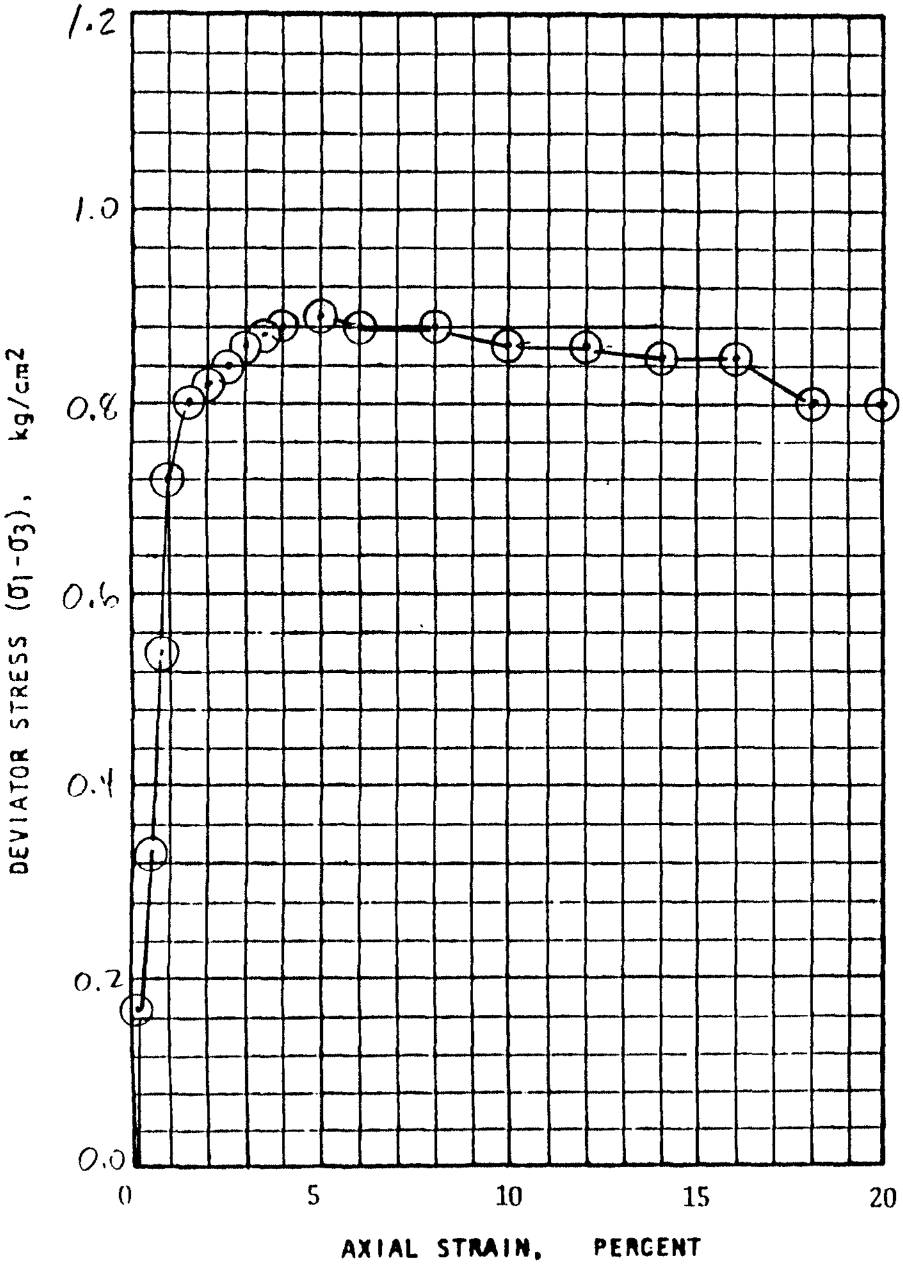
SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm2	DEVIATOR STRESS AT FAILURE kg/cm2	
	27.5	96.9	0.63	1.04	



PROJECT NAME CH2M HILL N.C. BRIDGES PROJECT NO. 10871A DATE 8/1/89

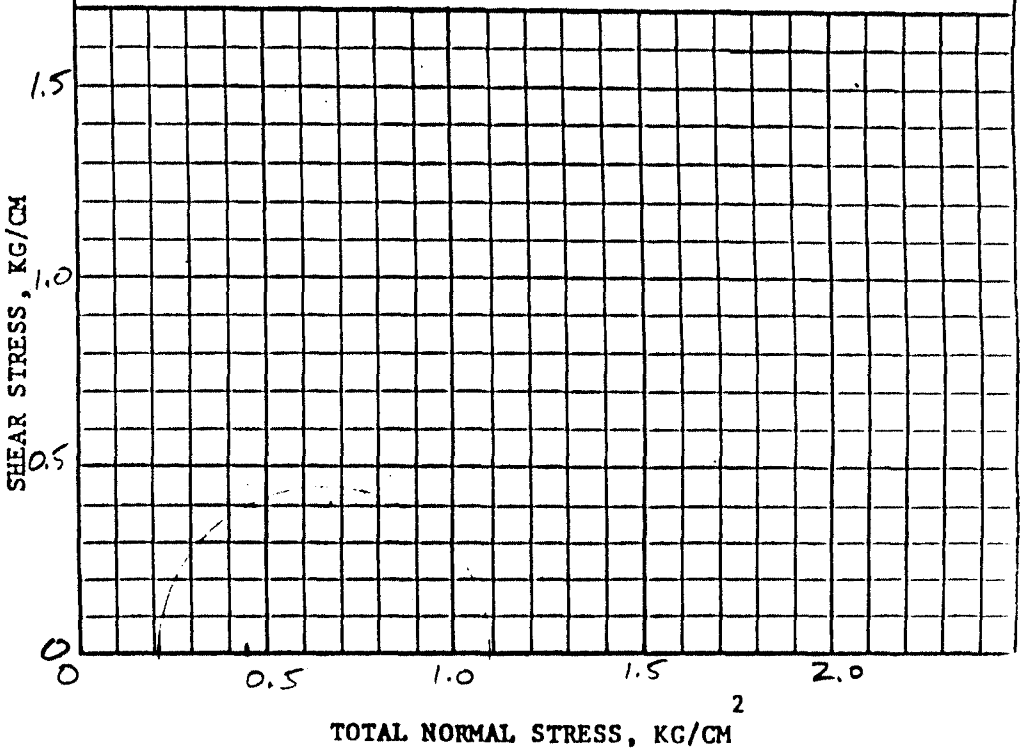
SAMPLE NUMBER B-2 ST-1 DESCRIPTION OF SAMPLE LT BRN SILTY CLAY

TESTED BY Ted Berger REDUCED BY Ted Berger CHECKED BY Sam Capps



Depth: 15-16.5 ft.
TYPE OF SPECIMEN: Undisturbed X Remolded
TYPE OF TEST: Unconsolidated-Undrained Triaxial

SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE kg/cm²	DEVIATOR STRESS AT FAILURE kg/cm²	
	24.5	99.6	0.21	0.89	



ACUREX Corporation

Environmental Systems Division

RECEIVED
JUL 13 1989
CH2M - HILL
SAN FRANCISICO

CH2M Hill
6425 Christi Avenue
Emeryville, CA 94608

July 10, 1989
Acurex ID: 8907007
Client PO: SF027979,BB.10
Page 1 of 6

Attention: Sybil Hatch

Subject: Analysis of 2 Soil Samples, Received 7/6/89.

Soil samples were analyzed for purgeable halogenated organic compounds according to U.S. EPA Method 8010 (Test Methods for Evaluating Solid Waste -- SW846, 2nd Ed.,1982). Results are presented in Table 1. The method can be summarized as follows:

> Helium is bubbled through an aliquot of sample in 5-mL of water contained in a specially designed purging chamber at ambient temperature. The purgeable halogenated organic compounds are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with helium to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a Hall detector.

Soil samples were analyzed for purgeable aromatic compounds according to U.S. EPA Method 8020 (Test Methods for Evaluating Solid Waste - SW846, 2nd Ed.,1982). Results are presented in Table 2. The method can be summarized as follows:

> Helium is bubbled through an aliquot of sample dissolved in 5-mL of water contained in a specially designed purging chamber. The purgeable aromatic compounds are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with helium to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a PID detector.

485 Clyde Avenue, P.O. Box 7044, Mountain View, CA 94039 (415) 961-5700 Telex: 325961 FAX: (415) 964-5145

If you should have any technical questions, please contact Daniel L. Middleton at (415)961-5700.

ubmitted by: Claudia Hidahl
GC Supervisor

Approved by: Daniel L. Middleton
Client Services Manager

These results were obtained by following standard laboratory procedures; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Volatile Organic Results

3010 Compounds	B-1 LAMBERT AVENUE ug/kg	B-3 PARK BVD DOWN STREAM ug/kg	Purge Blank ug/kg	Storage Blank ug/kg	Spike % Recov
Dichlorodifluoromethane	<5	<5	<0.5	<0.5	NS
hloromethane	<5	<5	<0.5	<0.5	NS
inyl Chloride	<5	<5	<0.5	<0.5	89
Bromomethane	<5	<5	<0.5	<0.5	NS
hloroethane	<5	<5	<0.5	<0.5	NS
richlorofluoromethane	<10	<10	<1.0	<1.0	NS
1,1-Dichloroethene	<5	<5	<0.5	<0.5	107
Methylene Chloride	<5	<5	<0.5	<0.5	NS
rans-1,2-Dichloroethene	<5	<5	<0.5	<0.5	85
1,1-Dichloroethane	<5	<5	<0.5	<0.5	NS
cis-1,2-Dichloroethene	<5	<5	<0.5	<0.5	81
hloroform	<5	<5	<0.5	<0.5	NS
,1,1-Trichloroethane	<5	<5	<0.5	<0.5	NS
Carbon Tetrachloride	<5	<5	<0.5	<0.5	86
,2-Dichloroethane	<5	<5	<0.5	<0.5	NS
richloroethene	<5	<5	<0.5	<0.5	83
1,2-Dichloropropane	<5	<5	<0.5	<0.5	NS
Dibromomethane	<5	<5	<0.5	<0.5	NS
romodichloromethane	<5	<5	<0.5	<0.5	NS
-Chloroethylvinyl ether	<5	<5	<0.5	<0.5	NS
trans-1,3-Dichloropropene	<10	<10	<1.0	<1.0	NS
,1,2-Trichloroethane	<10	<10	<1.0	<1.0	NS
etrachloroethene	<5	<5	<0.5	<0.5	88
Dibromochloromethane	<5	<5	<0.5	<0.5	NS
hlorobenzene	<5	<5	<0.5	<0.5	107
-Chlorohexane	<5	<5	<0.5	<0.5	NS
1,1,1,2-Tetrachloroethane	<5	<5	<0.5	<0.5	NS
Bromoform	<5	<5	<0.5	<0.5	NS
romobenzene	<5	<5	<0.5	<0.5	NS
,1,2,2-Tetrachloroethane	<10	<10	<1.0	<1.0	NS
1,2,3-Trichloropropane	<10	<10	<1.0	<1.0	NS
hlorotoluene	<5	<5	<0.5	<0.5	NS
,3-Dichlorobenzene	<5	<5	<0.5	<0.5	NS
1,4-Dichlorobenzene	<5	<5	<0.5	<0.5	NS
enzyl chloride	<10	<10	<1.0	<1.0	NS
,2-Dichlorobenzene	<5	<5	<0.5	<0.5	100
Date Analyzed:	7/7/89	7/7/89	7/7/89	7/7/89	7/7/89
urrogate	Percent Recoveries (%)				
romochloromethane:	100	99	97	99	101

NS - Not spiked

Table 1. Volatile Organic Results

CH2M Hill Sample ID

8010 Compounds	Dup Spike % Recov
Dichlorodifluoromethane	NS
Chloromethane	NS
Vinyl Chloride	96
Bromomethane	NS
Chloroethane	NS
Trichlorofluoromethane	NS
,1-Dichloroethene	117
Methylene Chloride	NS
trans-1,2-Dichloroethene	90
,1-Dichloroethane	NS
cis-1,2-Dichloroethene	84
Chloroform	NS
,1,1-Trichloroethane	NS
arbon Tetrachloride	85
1,2-Dichloroethane	NS
Trichloroethene	83
,2-Dichloropropane	NS
Dibromomethane	NS
Bromodichloromethane	NS
-Chloroethylvinyl ether	NS
rans-1,3-Dichloropropene	NS
1,1,2-Trichloroethane	NS
Tetrachloroethene	87
Dibromochloromethane	NS
Chlorobenzene	114
1-Chlorohexane	NS
,1,1,2-Tetrachloroethane	NS
Bromoform	NS
Bromobenzene	NS
,1,2,2-Tetrachloroethane	NS
,2,3-Trichloropropane	NS
Chlorotoluene	NS
1,3-Dichlorobenzene	NS
,4-Dichlorobenzene	NS
Benzyl chloride	NS
1,2-Dichlorobenzene	106
Date Analyzed:	7/7/89

Surrogate	Percent Recoveries (%)
Bromochloromethane:	104

NS - Not spiked

Table 2. Volatile Organic Results

CH2M Hill Sample ID

Method 8020 Compounds	B-1 LAMBERT AVENUE	B-3 PARK BVD DOWN STREAM	Purge Blank	Storage Blank	Spike
	ug/kg	ug/kg	ug/kg	ug/kg	% Recov
Benzene	<5	<5	<0.5	<0.5	100
Toluene	<10	<10	<1	<1	77
Chlorobenzene	<5	<5	<0.5	<0.5	101
Ethylbenzene	<5	<5	<0.5	<0.5	NS
Total Xylenes	<15	<15	<2	<2	NS
1,3-Dichlorobenzene	<5	<5	<0.5	<0.5	NS
1,4-Dichlorobenzene	<5	<5	<0.5	<0.5	NS
1,2-Dichlorobenzene	<5	<5	<0.5	<0.5	100
Date Analyzed:	7/7/89	7/7/89	7/7/89	7/7/89	7/7/89
Surrogate	Percent Recoveries (%)				
Bromofluorobenzene	98	81	91	89	112

Table 2. Volatile Organic Results (Continued)

CH2M Hill Sample ID

Method 8020 Compounds	Dup Spike % Recov
Benzene	106
Toluene	83
Chlorobenzene	114
Ethylbenzene	NS
Total Xylenes	NS
1,3-Dichlorobenzene	NS
1,4-Dichlorobenzene	NS
1,2-Dichlorobenzene	106
Date Analyzed:	7/7/89

Surrogate	Percent Recoveries (%)
Bromofluorobenzene	109

NS - Not spiked